Gas Journal

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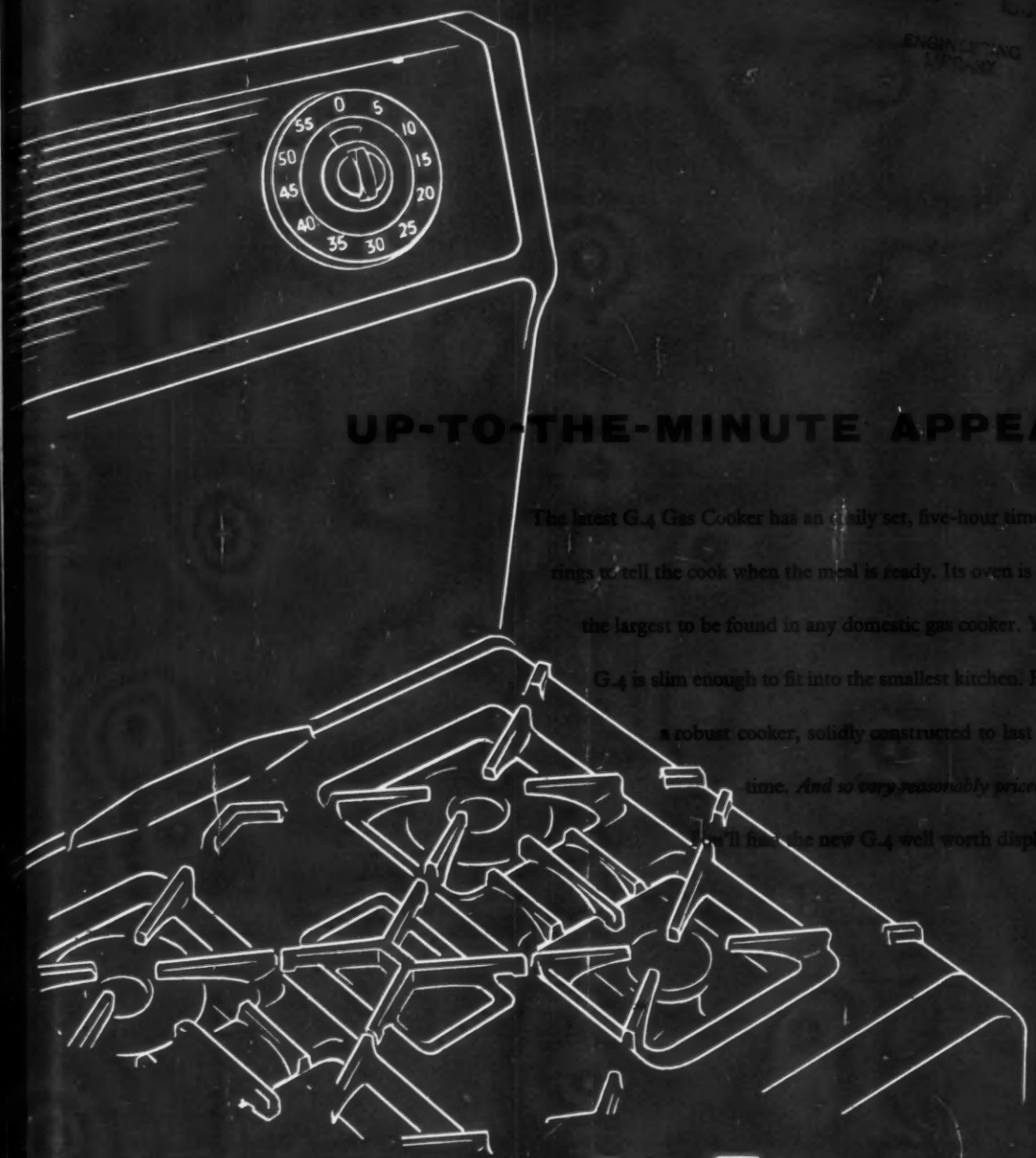

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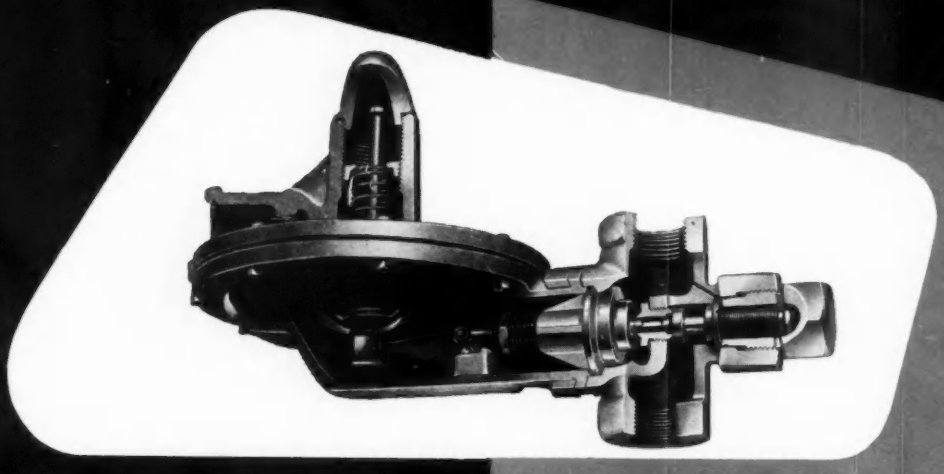

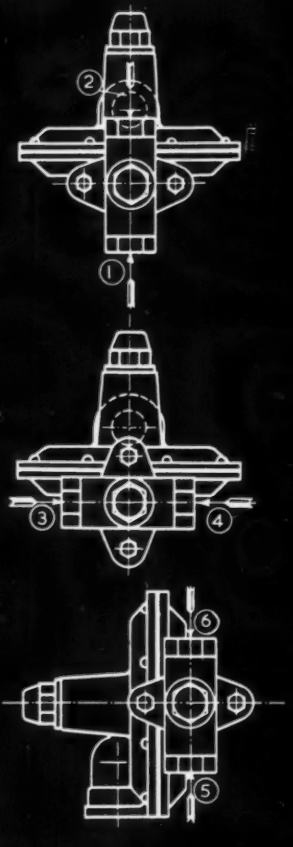

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Gas Journal

VOL. 293 NO. 4929 January 1, 1958

110TH YEAR

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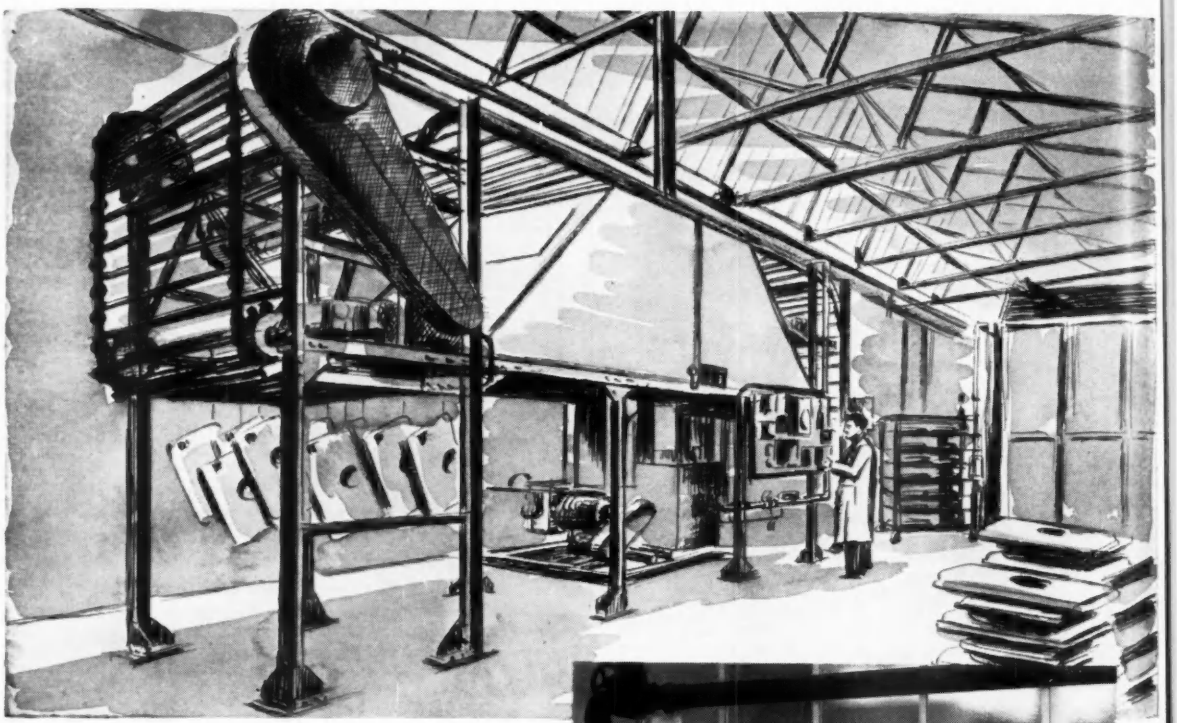

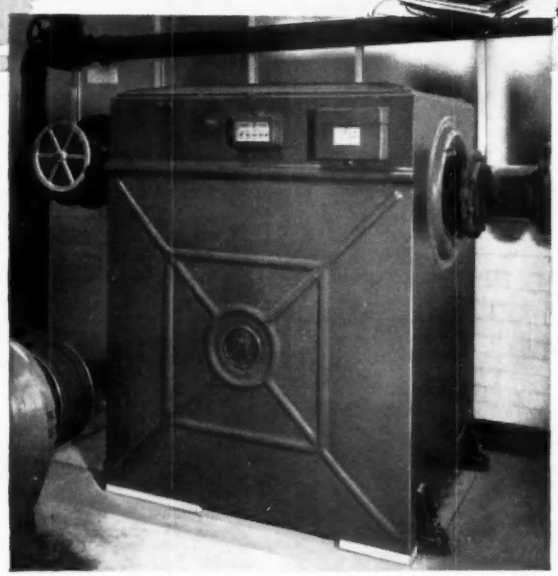

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Gas Journal

VOLUME 293. No. 4929. JANUARY 1, 1958. 110th YEAR

A Glimpse Behind the Iron Curtain

ANYTHING that goes on behind the Iron Curtain cannot fail to be of interest to everyone in the West. Russia seems to take a delight in being mysterious, and so when British industry is vouchsafed a chink in the curtain and allowed to see a little of what really does go on the other side, such chances should be utilised to the full. It was particularly fortunate that two such opportunities should have been offered to the National Coal Board within the last 18 months. The first occurred in the summer of 1956, when representatives of the mining industry were invited to spend a month in Russia to inspect the coalfields and to gain an impression of the level of development of mining techniques, the advances made in fuel technology, and the Russians' utilisation of energy from indigenous fuels. The other opportunity afforded to British industry was the invitation to travel to Russia made to a British team for the exchange of information on the techniques of underground gasification. This team spent a fortnight in Russia and returned early in December.

Russia, occupying a sixth of the land mass of the world and with a population of 250 mill, is comparatively sparsely populated for so large a country, especially when it is considered that 25 mill. families are still engaged in agriculture, the output of grain from which is greater than any country in the world. The coal fields, too, are vast; one in Northern Siberia is about the size of Britain and another is equal to the area of France and Germany.

Russia therefore has plenty of raw material to develop but she must also be ready to use the most important and up-to-date techniques. She is just as ready to learn from us as we are curious to see what she is doing. This is generally confirmed by the curious way in which the Iron Curtain suddenly snaps shut and refuses to be opened until the next opportunity is offered to the West —until in fact Russia is again thirsty for information.

These points and many others were made in an address given recently to the Institute of Fuel by Dr. Idris Jones, Director General of Research to the N.C.B., who was among those who visited Russia in 1956. He was most enthusiastic about the energy with which developments in the mining industry were being pursued. Up-to-date coal cutting machines were in evidence as well as experimental installations of hydraulic mining and the hydraulic transport of the coal won in this way from seam to surface. Oil drilling was being developed in a big way, and so was the exploitation of natural gas.

In European Russia, the natural gas is mostly found in the Caucasus and pipelines are in process of being laid to Moscow, the Ukraine, and as far as Leningrad and White Russia. In fact it is hoped to use it exclusively for power stations in the Moscow area within the very near future.

Underground gasification has been going in Russia for about 25 years and although there seem to be some major schemes in hand it does not appear likely that techniques there are very much more advanced than they are in Great Britain. In Russia the methods in use involve drilling bores from the surface about 27 metres apart in parallel lines, and then opening the seam by compressed air between the lines of bores, and igniting the coal. Such a technique has proved impractical in this country and, therefore, the system of ' blind bore holes ' has been adopted, but judging by the opinion of the latest team to visit Russia, her technologists too have had to modify their methods. They have succeeded in developing a directional drilling machine by which bores are made vertically into the seam; when the seam is reached the drilling head is turned at right angles and the bore is continued along the seam to meet another vertical bore from the surface. Such a machine sounds a little fantastic but the team was given sufficient information to enable a similar machine to be designed and built in this country. It is still uncertain to what extent the Russian fuel industry as a whole is really interested in this form of fuel. The coal fields are generally very remote places and transport is difficult and very costly, so why not convert the coal into power without the unpleasantness of mining and transport the power as electricity? Experiments in the use of oxygen-enriched air have been made but that only seems to have been done because air distillation plants were available and the prices for the inert gases obtained as by-products were particularly favourable.

There is no doubt that education is going ahead in Russia at a great rate. This is essential if the vast mineral wealth is to be exploited. It is not surprising, therefore, that mass production methods are being employed, helped by the excellent salaries paid to school teachers and science lecturers. Research is being carried out in a number of specialised institutes, but it is all very ' down to earth ' and technological in character. How much basic research is going on in Russia? How good are the Russians as craftsmen? These, we think, are two of the most important questions. For a nation to catch up with the rest of the world is only to be

expected if the local climate demands it, but if it is going to surpass the rest of the world, it must have original ideas and be able to work out new designs from fundamental knowledge, generally gained by intensive research. How much is there of this going on, or to what extent is it still necessary for information to be 'borrowed' from the West? Even America, supreme perhaps in technological research, admits that there is far too little basic research going on there, and this means that many new ideas must still be imported from Europe. If America is conscious of her deficiencies in basic research, how much more so might Russia be? We think that she will have more than enough to occupy her mind for some time to come.

Sulphur Dioxide

IN October, speaking to the Institution of Public Health Engineers, Dr. Parker returned to the subject of the removal of sulphur dioxide from the flue gases of the mammoth power stations. In the most promising proposal so far put forward the flue gas is scrubbed with a solution of ammonia salts to which ammonia is added at a rate corresponding with that of the absorption of the oxide of sulphur. Synthetic ammonia is more satisfactory for this purpose but it is more expensive than the crude concentrated liquor of the gasworks. On the other hand, if crude gas liquor is used it is necessary to treat the liquor finally obtained with a small amount of sulphuric acid in an autoclave at about 190°C. to convert the thiosulphate into sulphate and sulphur. Experiments have reached the stage of a large pilot plant. Estimates based on the use of concentrated gas liquor have been made. They indicate that the overall cost, including capital charges and allowing for the return from the sale of the products, would probably be in the region of 2s. 6d. per ton of coal burned.

Another difficulty which confronts this very promising solution of a troublesome problem is that the total amount of concentrated gas liquor that could be produced by the gas industry would only be sufficient for the flue gas from about 6 mill. tons of coal a year, whereas the power stations in Great Britain already consume about 45 mill. tons of coal a year.

What springs to mind is whether the time has not arrived to examine again the solution adumbrated in Mr. Ernest West's William Young Memorial Lecture in September. It will be recalled that an electricity generating station might be combined with gas-making plant. In other words, the coal would be completely gasified and purified from sulphur in some suitable combination of orthodox gasworks plant and gas would be used for steam raising in specially designed boilers but with nothing experimental about them. Mr. West had examined such a proposal in considerable detail in 1933, and at that date his estimation showed that including all charges gas at 370 B.Th.U. per cu.ft. could be delivered to boilers or gas turbines at around 1d. per therm. He suggested that at the present time and applying modern methods of complete gasification, the cost would be in the region of 4½d. per therm delivered to the electricity generating plant.

The attraction of this proposal is undeniable. The new methods of complete gasification are being applied to the low grade, small coals which form a large part of the intake of the power stations. It is possible that gas turbines are not yet available in large enough units to take the loads now customary but there seems no insurmountable difficulty in modifying big steam-raising units to take full advantage of a clean gaseous fuel. It is already recognised that the modern high power boiler must be a clean water boiler. Add to this a clean fuel, and availability would seem to be increased indefinitely. The gasholder would provide a useful tool in levelling out peak loads. By-products would be recovered from the gas-making process. And the problem of air pollution, whether by smoke, dust or sulphur dioxide from these highly concentrated centres of coal combustion, would be completely solved.

July to September Results

SALES of gas (according to meters read) in the six months ended September, 1957, were 2% below the level of sales for the corresponding six months of 1956. Analysis of sales by type of consumer shows that both domestic and commercial sales which were particularly affected by the warm spring and summer fell by 4%, but industrial sales increased by 2% compared with last year, with the increase in industrial production in the vehicle and other manufacturing industries. The average revenue per therm of gas sold rose from 18.9d. per therm to 19.8d. per therm.

Production figures show that the output of gas was 3% below the level for the corresponding six months of 1956. Coal gas manufacture was reduced 5%, but the output of water gas was stepped up 14%. Oil gas production has increased from 2.2 mill. therms in April to September, 1956, to 3.9 mill. therms in April to September, 1957. The quantity of coal carbonised was 6% down on the same period of last year, but coke and oil used in water gas manufacture were 9% and 17% above last year's figures respectively. Surplus gas purchased from coke ovens and oil refineries was 8% up on the corresponding six months of 1956, and total gas made and purchased 1% down.

Coke production was 6% below that for the April to September period of 1956, the sales of coke were reduced by 4%. The output of crude coal and oil gas tar was down 5% and the output of crude benzole was down by 18%.

Sales of appliances showed some recovery compared with the corresponding six months of 1956. Sales of gas cookers showed a 2% increase over last year, 260,000 being sold as against 255,000 sold in April to September, 1956. Sales of refrigerators increased by 64%, but sales of gas space heaters and water heaters fell by 24% and 5% respectively.

New gas-making plant of 29 mill. cu.ft. capacity was brought into use during the first half of 1957-58. This compares with a figure of 44 mill. cu.ft. in the first six months of 1956-57. An increase of 1,078 miles was made to the length of mains laid, 3% less than the increase in the corresponding six months of 1956.

There was again a reduction in the total number of employees in the gas industry. At the end of October, 1957, the number employed was 2% below the figure for the end of October, 1956.

Personal

MR. J. TUFFILL, familiar to many in the gas industry for his work in helping to organise Gas Sales and Service Conferences, has left the Gas Council for a commercial post with a firm of London printers.

MR. J. W. HOLROYD, District Manager, Rotherham District of the East Midlands Gas Board, recently received a presentation to mark his retirement. Our picture shows a group surrounding Mr. Holroyd after his presentation, consisting of MR. C. C. WOOD; MR. E. B. FIELD, Deputy Divisional General Manager, Sheffield and Rotherham Division; MR. W. J. STEED, Divisional Sales and Service Manager, Sheffield and Rotherham Division; and MR. S. DAVIES, District Manager, Doncaster District, Sheffield and Rotherham Division. Mr. Holroyd retired at the age of 65, having served 48 years in the gas industry. He commenced his working life with the Elland Gas Company and subsequently was appointed to Distribution Engineer, Rotherham Gas Department and at vesting date became District Manager of the Rotherham District.

Mr. Sydney Smith, Chairman of the Scottish Gas Board, is seen with Mrs. Smith and his elder son, Ian, outside Buckingham Palace after being invested with the C.B.E. which he was awarded in the Birthday Honours.

MR. J. E. C. BAILEY, C.B.E., Chairman and Managing Director of Baird and Tatlock (London), Ltd., and Hopkin and Williams, Ltd., is leaving the United Kingdom on January 18 to visit the Companies' branches, agents and representatives in Rhodesia, South Africa, Australia, New Zealand, Singapore, and Ceylon.

MR. M. GREGORY has been appointed Deputy Station Engineer, Bromley, and Mr. P. J. SAVAGE, Senior Assistant Engineer, Bromley, by the North Thames Gas Board.

MR. P. G. WRIGHT, formerly Administrative Secretary at Watson House, has been appointed by the North Thames Gas Board, to be Secretary of the Watson House Centre, and MR. R. C. W. T. SALUSBURY, Assistant Secretary. Mr. Salusbury is posted to Watson House from the Board's Central Services Section. The appointments follow the resignation of Mr. Emrys-Roberts as Technical Secretary at the Centre.

Left, Mr. R. C. W. T. Salusbury; right, Mr. P. G. Wright.

MR. VICTOR THOMAS, who was General Sales Manager of Fielden Electronics, Ltd., is no longer with the Company.

J. R. W. ALEXANDER has been elected to the Council of the London Chamber of Commerce, which has over 13,000 members.

Diary of Forthcoming Events

January 6.—INSTITUTE OF FUEL (NORTH-EASTERN SECTION): King's College, Newcastle-on-Tyne. Ladies' Night. 'Oil Fuel at Home,' by K. S. Brett. 6.30 p.m.

January 7.—EAST MIDLANDS G.C.C.: Smithy Row, Nottingham. Ordinary Meeting. 11.30 a.m.

January 7.—INCORPORATED PLANT ENGINEERS: 25, Charlotte Square, Edinburgh. 'Construction of a welded pipeline,' by R. Downie. 7 p.m.

January 7.—INCORPORATED PLANT ENGINEERS: Royal Society of Arts, John Adam Street, W.C.2. 'A practical survey of automatic combustion regulation on industrial boilers,' by W. R. L. Kent, of Kelvin & Hughes. 7 p.m.

January 7.—MIDLAND JUNIORS: 'Atomic Energy,' by Mr. B. R. Payne, of the Atomic Energy Research Establishment.

January 8.—INSTITUTE OF FUEL: Great George Street, S.W.1. 'The Influence of the Absorption of Frothing Agent on the Percentage Recovery of Coal from Flotation Pulps,' by Dr. A. Jowett. 5.30 p.m.

January 8.—INSTITUTE OF FUEL (SOUTH WALES SECTION): Abbey Works, Port Talbot. 'Planning Construction and Problems associated with Berkeley and Dounreay Power Stations,' by P. K. Richards. 6 p.m.

January 8.—INCORPORATED PLANT ENGINEERS: Grand Hotel, Bristol. 'Education in Industry,' by E. G. Sterland. 7.15 p.m.

January 8.—INCORPORATED PLANT ENGINEERS: County Hotel, Nottingham. 'The petroleum industry,' by J. Collins. 7 p.m.

January 8.—INSTITUTION OF GAS ENGINEERS (SOUTH WESTERN SECTION): Queen's Hotel, Cheltenham. 'The Place for Conventional Forms of Fuel in the Future,' by Dr. D. C. Rhys Jones. Meeting preceded by a visit to the Coal Research Establishment at Stoke Orchard, Cheltenham.

Obituary

MR. A. P. KELSEY has died, aged 73. Mr. Kelsey joined Falk, Stadelmann & Co., Ltd., in 1899, and after training became Personal Assistant to the late Mr. Max Falk. Subsequently, he called on gas undertakings throughout the country. In later years, Mr. Kelsey represented Stoves, Ltd., selling Newhome gas cookers, and became a Director of this firm. He retired five years ago.

CORRESPONDENCE

Debtors and Creditors Co-operate over Cheques Act

Major Reform Brings Substantial Savings in Time and Money

SIR,

Although the current practice of dispensing with receipts for payments made by cheque involves administrative changes, there is every reason to conclude that debtors and creditors are generally co-operating in taking full advantage of the substantial savings of time and money afforded by the major reform which the Cheques Act comprises. These changes necessarily take longer to introduce in large and complex organisations, such as public utilities.

While it is necessary that the debtor should indicate to the creditor to what transactions his payment relates, he should normally not return the invoices to the creditor. With his cheque the debtor can return the creditor's periodic statement, or he can attach a remittance slip showing debits, credits, and the amount paid, or he can use the back of the cheque for the purpose. The procedure is simplified if the creditor provides this remittance slip, or a duplicate statement or invoice for retention by the debtor.

The paid cheque constitutes a receipt and, when attached by the debtor to the discharged invoice, effectively links transaction and payment. Accounting is facilitated if the invoice is endorsed with the cheque number when drawn, while the face of the cheque may be marked with numerals which link it with the transaction.

There has now arisen a widely held belief that a receipt, if given, does not now require a twopenny stamp if the amount is £2 or upward, or that a receipt can be refused if demanded. Strictly speaking it can be, for there is in law no right to demand or obligation to give a receipt, but if one is specifically refused the creditor is liable to a Revenue penalty of £10, but only if the amount is £2 or upward.

The Cheques Act, 1957, did not eliminate the receipt or establish the principle that a paid cheque is *prima facie* evidence of payment; this was decided in the courts 157 years ago. What the Act does, in eliminating the necessity for the endorsement of cheques, is to extend that principle from the endorsed to the unendorsed cheque.

Of interest is the recent statement by the Chancellor of the Exchequer that the Inland Revenue would accept an unendorsed paid cheque, together with the unreceipted accounts or invoices, in support of claims by the taxpayer.

Yours faithfully,

J. R. W. ALEXANDER, Chairman,
Cheque Endorsement Committee,
Chartered Institute of Secretaries.

14, New Bridge Street, London, E.C.4.
December 23, 1957.

THE CRADOCKS DID NOT WISH TO GET AWAY WITH AN INDISCRETION

DEAR SIR,

With reference to your remarks on ourselves and our activities contained in the text of page 443 of your issue of November 27—this has only just been brought to our notice which will, we trust, explain our delay in replying.

May we make it abundantly clear that the last thing we wished for was that 'the Cradocks would get away with this indiscretion,' and we offer to give you the names of eminent professional caterers who have wholeheartedly agreed with us.

In the interests of the nation's gas consumers who, like ourselves, are cherishing the belief that the nationalised gas industry is above bias—may we ask you if you would not consider us worthless and contemptible if we praised unworthy establishments whether serviced by gas, electricity, or solid fuel?

It has always been our policy—in fact it is the policy which has made our name—to put the fullest possible limelight on the good and denigrate the shoddy. If indeed we are deluding ourselves that the professional standard is generally low, how, can you explain, is our professional catering a bad joke throughout the world?

We are not 'linked with gas,' *we are wedded to gas.* What we cannot comprehend is how our criticisms of poor cooks and ineffective managements can possibly denigrate gas. Even we could burn toast under a gas grill—and if we did so would you not say that the fault was in our foolishness and not in our gas grill, for otherwise your comments raise the most singular problems if they are to be considered seriously.

Are we to be divorced by gas if we do not confine our journalistic activities to comments dictated by the gas industry? If this were so, we should be relegated to the unemployment lists by Fleet Street overnight, we should lose the entire reputation we have built up over the past nine years and instead of being looked up to by the public as incorruptible we should rightly be made useless to the gas industry or anyone else.

With all respect, we submit that your remarks are so damaging to us that in all fairness you owe to us the freedom of your column to make a full reply.

Yours faithfully,

PHYLLIS AND JOHN CRADOCK.

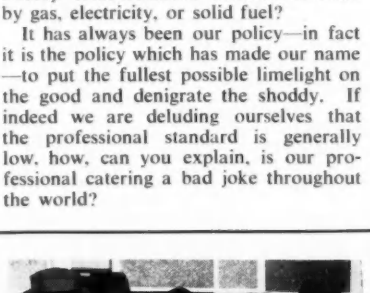
29, South Terrace, S.W.7.
December 18, 1957.

Freedom of Choice

Stirling Town Council has agreed, with regard to future housing schemes, that tenants should have freedom of choice between gas and electric appliances. The Housing Committee's recommendation for all-electric houses was rejected.

Correction

We regret that due to an oversight Newcastle showroom was attributed to the North Western instead of the Northern Gas Board on p. 699 of our December 25, 1957, issue.



Pictured above during the visit of a section of the Canadian trade mission to the Darlington works of Whessoe, Ltd., are (left to right) Mr. M. J. Noone, Director & Manager of Operations, Whessoe, Ltd.; Mr. Humphrey B. Style, President of John Inglis and Co., Ltd., Toronto; Mr. R. Slater, Works Manager, Whessoe, Ltd.; Mr. R. A. Jolly, of the Board of Trade, Newcastle; and Mr. J. George Johnston of Johnston, Everson and Charlesworth, Toronto.

NEW RANGE OF CUT-OFF VALVES

The Jeavons Engineering Company have recently introduced a newly designed range of aluminium type J54 press button controlled weep re-set cut-off valves, which have low cut-off pressure (8/10 in. W.G. minimum) and are therefore ideal for industrial and other purposes. The unique position of the press button facilitates manipulation when the unit is close to a wall or in a confined space. These valves are made in sizes ¼ in. to 3 in. with B.S.P. connections and 4 in. to 12 in. with flanged connections. This and other type cut-off valves are fully illustrated and described in the Company's brochure 54/1/58.

Canadian Gas Company has Year of Intense Activity

IN his report for the year ended June 30, 1957, Mr. John A. McMahon, President, said that the Inland Natural Gas Co., Ltd., of Vancouver, had had a year of intense activity both at the organisational and construction levels.

'During the year we completed the financing of the Inland transmission and distribution systems with the sale of 250,000 5% cumulative redeemable preference shares (par value $20 per share); $8,000,000 5½% convertible sinking fund debentures, series A; and $15,000,000 6% first mortgage sinking fund bonds, series A,' said Mr. McMahon. 'Of the 5½% convertible sinking fund debentures, series A, issued in February, 1957, a total of $826,500 were converted to common stock as at August 30, 1957.

'At the same time our registered common shareholders numbered more than 3,000 and there were 2,434 holders of the 5% preference shares. By far the largest number of both were held in British Columbia and most of the balance of the shares are held in other Canadian provinces. There are now a large number of shares held in the United States, the United Kingdom and other countries.

'At this time I can report that we have completed the building of 360 miles of transmission line and the installation of distribution systems in 27 communities in interior British Columbia. We are now receiving natural gas from Westcoast Transmission Co., Ltd., which is approximately 30 days ahead of schedule.

'Inland's wholly-owned subsidiary companies have also enjoyed a satisfactory year.

'Canadian Northern Oil & Gas Ltd. and St. John Gas & Oil Co., Ltd. have drilled several successful gas wells. Canadian Northern Oil & Gas Ltd. has a 37½% interest in 14 producing wells situated in the South Pouce Coupe field. The open flow production of these wells is 284.5 mill. cu.ft. of gas a day. Daily production rate of deliverable gas is estimated at 34 mill. cu.ft. a day from the wells in which St. John Gas & Oil Co., Ltd. holds a 4.05% interest.

'Our two subsidiary transmission lines have also shown considerable gains in volume of gas carried in the past year, although revenues were slightly lower. Revenues from these pipelines reflect a change in rates from a flat rate to a load factor basis. The new rate basis is designed to attract new business, but was only in effect for ten months of the past year. Had it been in effect for the entire year, the revenues would have been slightly higher than in the previous year.'

Humphreys & Glasgow, Ltd.

CONTRACT AWARDED FOR £50,000 C.W.G. PLANT IN HOLLAND

THE contract for a 'labourless' carburetted water gas plant of 1.75 mill. cu.ft. daily capacity for the Haarlem gas undertaking, Holland, has been awarded to Humphreys & Glasgow, Ltd.

The plant, which will cost nearly £50,000, will be designed for the reforming of refinery or natural gases. It will be completed ready for operation by next November.

A similar plant was installed at Haarlem by Humphreys & Glasgow in 1952. Automatic controls enable that plant to be operated by a single man. No additional labour will be needed when the new plant is installed, both plants being controlled by the same man.

The new plant is self-clinkering and is designed to recover steam from waste heat.

Humphreys & Glasgow have just completed another carburetted water gas plant, also of 1.75 mill. cu.ft. capacity, at Delft, Holland.

N.C.B. ORDERS EXPENDITURE STANDSTILL

But Miners' Union says Thousands are Wasted

THE National Coal Board has ordered a three-year standstill in its 'non-operational expenditure.' No more officials will be taken on and no more money will be spent unless directly related to increasing coal production, said the Chairman, Sir James Bowman, recently.

But the National Union of Mineworkers' clerical section says too many officials have recently been appointed who have made 'absolutely no contribution to the efficiency of the industry.' There is a deep-rooted feeling among the Board's clerical staff, says an article in the N.U.M. clerical journal, that thousands of pounds are being wasted.

This wastage is caused by the creation of unnecessary posts, the appointment of unsuitable candidates to a number of posts, and inefficient administrative practices and methods of organisation, the article claims.

Calor Gas Holding Co., Ltd. Makes Increased Profit

PROFITS of the Calor Gas Holding Co., Ltd., for the year ended July 31, 1957, amount to £514,356 after charging £481,292 for depreciation as compared with a profit of £486,853 after charging £418,354 depreciation for the previous year, the annual report reveals.

Taxation on the profits for the year amounted to £310,138. This figure is relatively higher than that charged in the previous year by reason of the increased rate of profits tax applying to the additional distribution in respect of the new capital and to the cessation of investment allowances.

The proceeds, less expenses of the issue of 492,486 shares of 5s. each in accordance with the circular to shareholders dated November 23, 1956, at a premium of 16s. per share, amounted to £499,281, out of which the share premium (less expenses of issue) of £376,160 was subsequently utilised together with £239,448 from general reserve in making the bonus issue of one new share for every one share held on June 24, 1957.

Current assets have been increased by £370,247 to £1,306,407 and exceed current liabilities and provisions by £507,194 as compared with a deficiency of £72,199 at July 31, 1956.

Rome Conference

The Council of the International Gas Union has decided to hold its 7th International Gas Conference, in Rome, on September 22 to 25.

Midland Juniors Visit G.E.C. Witton Works

SOME 40 members of the Midland Junior Gas Association visited the Witton works of the General Electric Co., Ltd., in November. This is one of the largest group of factories in the world manufacturing electrical products.

The party was entertained to lunch at the Royal Hotel, Sutton Coldfield, where they were welcomed by Mr. A. C. Davies, Manager, Heavy Plant Sales; Mr. Hayes, Branch Engineer, Birmingham; Mr. R. Barron, Branch Sales Manager; Mr. Rollinson, Manager, Training and Education Department; and Mr. H. Steggles, Home Sales Department, London.

During the tour of the works the members visited the high voltage laboratory; the transformer works; the switchgear works; the heavy engineering works; and the main engineering works.

Pipe here was laid under a river, fitted with concrete weights. Each pair of weights shown here totals 5,200 lb.

SPECIAL REPORT

FROM

HILDING CARLSON

CANADIAN PIPELINE INTO U.S.A.

CANADIAN gas started moving into the United States, October 8, through the just-completed 650-mile, 30-in. pipeline of Westcoast Transmission Co., Ltd., at an initial rate of 60 mill. cu.ft. per day. Construction of the line began in the spring of 1956.

It has been the most embattled pipeline-project on the continent. Since 1949, the Company had sought to connect the vast and yet-unmeasured reserves of natural gas in the provinces of British Columbia and Alberta to the market areas in Canada and in the industrialised North-west U.S. It has endured opposition in the Canadian Government and in the two provinces; hearings before the U.S. Federal Power Commission on the importation of Canadian gas featured interventions and oppositions, established a hearing-duration record, and ended in a denial of the Westcoast application.

The £60,725,000 pipeline has a basic capacity of 400 mill. cu.ft. per day with provisions for expansion to 660 mill. Its route is from the Peace River producing area, straddling the B.C.-Alberta provincial border, then over the Rocky Mountains and the Cascade Range to Bellingham and Huntingdon at the international border. There, it connects with the U.S. gas system of Pacific North-west Pipeline Corporation.

SIGNIFICANT EVENT

As Premier W. A. C. Bennett of British Columbia opened the valve at Huntingdon to start the gas flow into the U.S., he commented that the event might well be regarded as the most significant for the province since the Canadian Pacific Railway reached the West Coast in 1886.

Mr. Ray Reirson, Alberta Minister of Mines, celebrating the Huntingdon opening with Mr. Frank M. McMahon, Westcoast President and all other Company executives, predicted that the exportation of gas by Canada would reduce the Dominion's trade deficit with the U.S.

The magnitude of the Westcoast project is heightened when the designed maximum capacity of 660 mill. cu.ft. per day is related to electric energy in the area it will serve. The Company notes it 'is equivalent to 10.8 mill. H.P., or four times more than all the energy developed by the present hydro-electric installations of British Columbia' and that it is 'approximately equal to the combined power output of Bonneville and Grand Coulee dams' in the U.S.

The Westcoast project provides the first major example of an international

gas grid, which will have high importance in the economics of Canada and the U.S. Mr. McMahon commented. Also, he noted significantly, 'It is a fine example of the mutually advantageous use of otherwise dormant natural resources.'

While the Canadian gas resources at Peace River, lacking a sufficient market, could not have been developed, the exportation to the sizeable U.S. market takes into consideration the foreseeable needs in the Dominion itself. With the opening of the Westcoast system, gas began moving through the system of British Columbia Electric Company for distribution in the industrial area of Vancouver and the Lower Mainland. Inland Natural Gas Company, Ltd., will distribute the gas in the interior districts of B.C.

PROVED RESERVES

Recoverable natural gas reserves in Alberta have been estimated variously by geologists and some indications are that the presently 'proved reserves' are the order of 20 trillion cu.ft. However, Mr. Ralph E. Davis, independent consulting geologist, told the Westcoast management, 'Based on the high incidence of discovery of gas in the Peace River area during a relatively short period, the presence of other favourable structures as outlined by exploratory mapping and the largely unexplored formations at greater depths, I am forced to conclude that the presently proved reserves are a minor portion of the ultimate gas resources of the region.'

More than 80% of the terrain on the route of the Westcoast pipeline is forest land. The altitude varies from sea level to a high point of 3,300 ft. in Pine Pass of the Rocky Mountains and another of 4,510 ft. in Coquihalla Pass of the Cascade Mountains. The construction problems are further indicated by five major aerial pipeline-bridge river crossings and two submerged crossings. Others include 41 railway crossings, 66 cased highway underpasses and crossings of 70 small streams and creeks.

The route runs through 491 miles of provincial and federal lands. It touches 15 Indian reservations where the necessary easements were acquired through application to the Federal Indian Affairs Department and through meetings with the chiefs and councillors of the Indian tribes. Other easements were obtained throughout the Province from 1,150 private landowners whose holdings ranged from town lots to million-acre ranches.

The 650 miles of 30-in. pipe in the main line, plus 37 miles of 26-in. and 186 miles of various sizes, account for 230,426 tons of steel. Of that total, 96,000 tons valued at approximately £5,350,000, were imported from South Durham Steel & Iron Company, Ltd., Stockton-on-Tees.

INITIAL CAPACITY

Four compressor stations are spaced approximately 160 miles apart, with an aggregate of 52,500 installed horsepower, to move the initial capacity of 400 mill. cu.ft. per day. The designed system will incorporate five additional compressor stations as they are required to raise the system capacity to 660 mill. cu.ft.

Westcoast estimates that £35,715,000 of the total cost, £60,725,000, were for Canadian materials and labour. The construction period utilised personnel totalling 2,200. Now, operations will provide employment for 400.

The trench for the pipeline, 4 ft. wide and 6 ft. deep, was excavated in the 60-ft. right-of-way. That required handling 7 mill. tons of soil and stone.

Mainline and compressor station contractors were Dutton-Williams Brothers, Ltd.; Canadian Bechtel, Ltd.; Conyes Construction Corporation; Mannix, Ltd.; Stearns-Roger Engineering Company, Ltd.; Marwell Construction Company, Ltd.

The construction of the overall project was managed by Canadian Bechtel, Ltd. Ford, Bacon and Davis, Inc., were the consulting engineers.

In addition to the pipeline, the Westcoast project includes a gas scrubbing plant at Taylor, B.C. This will be part of a large gas processing facility to be established there, with Pacific Petroleums, Ltd. and Phillips Petroleum Company participating. The gas cleaning and dehydration facilities have been calculated to produce 300 tons of sulphur per day, 1,560 barrels of aviation petrol, 1,700 barrels of motor and diesel fuels, and 500 barrels of propane. Jefferson Lake Sulphur Company will have a more-than £1 mill. sulphur plant at Taylor.

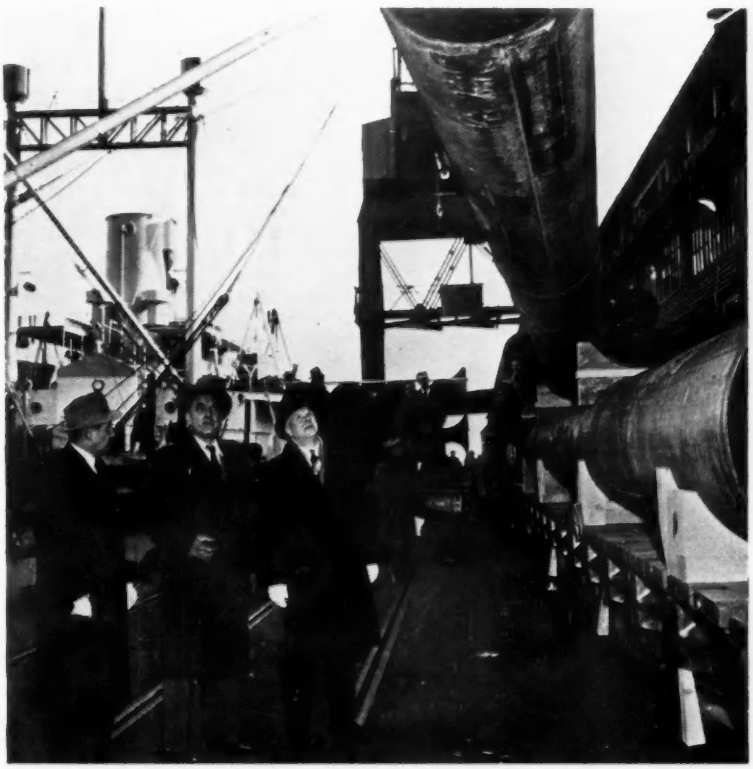
Westcoast Transmission Company, Ltd., was formed almost entirely on the basis of the conviction of one man that the natural gas in Western Canada should be brought to market, economically sound, efficiently handled and profitably sold. Mr. Frank M. McMahon, the Company's President, has fought, in possibly not a completely figurative manner, to bring that gas over the mountains.

The Company was incorporated by special Act of the Parliament of Canada in April, 1949. Immediately, the anticipated difficulties became fact.

FIRST OBSTACLE

The Province of Alberta presented the first obstacle by withholding approval for the movement of Alberta gas over the provincial line into British Columbia, despite the relatively small gas market within its borders. Hearings on the Company's application extended over three years. Finally, in 1952, Westcoast was authorised to export gas. British Columbia promptly endorsed the approval in the interests of that province and the national economic benefits that would accrue from exporting gas to the U.S.

The Canadian Board of Transport Commissioners, the authority having jurisdiction over interprovincial pipelines,



The first shipment of steel from Great Britain for the Westcoast line was met in Vancouver by (left to right) Mr. Harry F. Waste, Vice-President and Project Manager for Canadian Bechtel, Ltd.; Mr. Norman R. Whitall, Vice-President and Director, Westcoast Transmission; Mr. Einer Gunderson, Financial Adviser to B.C. Premier; W. A. C. Bennett.

then gave approval for the necessary construction of facilities.

With the importance of the market in North-west U.S. in mind, Westcoast Transmission Company, Inc., was formed in the U.S. as a wholly-owned subsidiary, to build and operate a transmission system in the states of Washington and Oregon for the gas the Canadian company would deliver at the international border. That was the point when Westcoast's difficulties reached the rough phase.

The scene shifted to Washington on June 16, 1952, when the American company's application to the Federal Power Commission came up for hearing. That hearing is best remembered for its fivering circus character.

A competitive application by Pacific Northwest Pipeline Corporation, a Texas group, proposed to build a line from the San Juan Basin in New Mexico and Wyoming for the delivery of gas to the market contemplated by Westcoast. That market was the economic key that would make the Canadian project feasible.

While many thousands of pages of testimony were being piled up in Washington as the record of two years of hearings, local efforts in North-west U.S. sounded for and against Canadian gas. Possibly the most noticeable individual performer was Mr. N. Henry Gellert, President, Seattle (Wash.) Gas Company. Complete with cowboy trappings, television and radio appearances, and a flow of publicity that was accorded little dignity by gas industry editors, Mr. Gellert carried the wavering torch for the application of Pacific Northwest Pipeline, Westcoast's competitor, and proclaimed the coming of natural gas.

He criticised the Canadian project, in an address before the New York Society of Security Analysts, in May, 1953, making a number of points on insufficiency of the Canadian gas reserves, the route of the Westcoast line and the applicable Canadian laws.

'BASIC CONDITIONS'

Mr. Gellert told the analysts that in a brief submitted to Federal Power Commission, he had 'laid down . . . basic conditions' including one specifying that 'if the gas comes from a foreign country, a guaranty, by treaty, that there will be no curtailment of our contracted-for gas supply for the benefit of foreign customers, whether connected to the line or not.

'We are foreigners to Canada, and we, as an American public utility, are unwilling to become an economic vassal of a foreign power,' he declared.

All in all, Mr. Gellert's expressions reflected his dim view of the Westcoast project, a complete disregard for Canada's economy and Canada generally. Mr. Gellert is no longer President at Seattle; even the name of the Company has been changed to Washington Natural Gas Company.

Well-informed Canadians and Americans, especially those who have spent time on the 'other' side of the unfortified 3,000-mile border, do not think or speak of each other as 'foreigners.' In fact, that attitude is much more likely to be expressed by natives of one section of the U.S. toward those in another.

Mr. Gellert's remarks were countered with high adequacy a month later when Mr. Charles H. Gueffroy, President, Portland (Ore.) Gas & Coke Company, addressed the same New York Society of Security Analysts.

With immediate reference to Mr. Gellert, Mr. Gueffroy said, 'He expressed a point of view as to trade relations between the United States and our neighbour to the North which seems to me blatant nonsense.' After quoting Mr. Gellert's we-are-foreigners declaration, Mr. Gueffroy commented, "Now that is tripe!"

As to the demand for a 'treaty,' Mr. Gueffroy read to the analysts a significant portion of a letter from B. C. Premier W. A. C. Bennett to Mr. Lloyd K. Turner of Westcoast Transmission.

GREAT CRIME

'I am sure,' the Premier wrote, 'as you and the Federal Power Commission must be, that there would be no interference with the export of natural gas from our Peace River field to the Pacific North-west portion of the United States. It is clear that with the great shortage of power developing in the Pacific Northwest, it would be a great crime if the natural gas deposits in our Peace River territory were not utilised at this time.'

Mr. Gueffroy expressed a widely-held opinion in the U.S., that 'the export of natural gas from north-western Canada on a basis profitable to the citizens of both countries obviously would be in accord with the basic policies established by the governments of the United States and Canada. . .'

Federal Power Commission rendered its decision, June 18, 1954, in the hearings that commenced in June, 1952. It approved the line proposed by Pacific Northwest Pipeline. Gas to North-west U.S. was to come from the San Juan Basin.

The immediate effect of the announcement was evident in Canadian newspapers which broke out their biggest and blackest headline type for dire predictions. Clearly and understandably, the decision had the effect of bottling up the tremendous gas reserves. Resentment, again understandable, was strong.

From the point, Pacific Northwest Pipeline can be characterised as an on-again-off-again project. Questions were raised about the cost and the heavy proportion of bonded indebtedness that was planned. Mr. Gueffroy, a prospective customer, became particularly vocal on the type of rate structure that the pipeline proposed to the undertakings on its route. In effect, the contract provided for the payment of gas, even though the undertakings could not take the gas in relation to their customers' demands . . . a 'take or pay' contract, that is called in the U.S.

At times, sources close to the project predicted that it would be abandoned. But, a Moses came along to lead it out of the wilderness.

Mr. Paul Kayser, the astute and respected president of El Paso Natural Gas Company, another Texan, is quite generally believed to have been the guiding spirit who revised the structure of the Pacific Northwest Pipeline project, including the addition of a leg to the California market. Shortly thereafter, the project was off the ground, under construction and is now in service.

Early this year, observers of the American gas scene could find little surprise in the announcement that Pacific Northwest Pipeline had become a subsidiary of El Paso Natural Gas Co. The latter, thereby, became the largest gas system in the world and promptly became a target for the U.S. Department of Justice under anti-trust laws.

As is usual in the expansion of the American gas industry, Pacific Northwest Pipeline found that it needed more gas, especially in view of its California deliveries.

In the Spring of 1956, Westcoast Transmission Company Ltd. could start construction on the Alberta-British Columbia project with confidence that its gas would find an economic market, even though it would be through the system of Pacific Northwest Pipeline, its recent adversary.

Westcoast gas now can move southward and eastward from the states of Washingon and Oregon, to California, New Mexico, Arizona, Colorado, Utah, Idaho, and Wyoming.

Initial financing of Westcoast Transmission Company Limited was concluded as the largest private arrangement in western Canadian history, based entirely on the merits of the project without governmenal guarantee or subsidy. Mr. Frank M. McMahon, President, said that it was accomplished 'on very satisfactory terms,' for the Company.

DRY HOLES

Mr. Frank M. McMahon knew, somehow, that there was gas in virtually the backyard of his birthplace in Moyie, south-west British Columbia. True, he ranged from Alaska to Mexico in his searches for oil and gas, but he did come home to B.C. to bring out the gas for the company he heads, with his office in nearby Vancouver.

From his first job in the Sullivan Base Metal Mines, near his home, after he had attended Gonzaga University in Spokane, Wash., Mr. McMahon went prospecting and working for drilling contractors in three countries of the Pacific Coast. A 'wildcatter' knows, when he starts drilling, that one of two results will surely be his: He will stop drilling his dry hole, without as much as a well-worn dime, in which case he is very likely to turn up again somewhere for another try, or the top might be blown off his drilling rig as the crude oil blasts its way to the surface and blasts him to riches. Mr. McMahon had his share of dry holes.

In March, 1948, Atlantic No. 3 'came in' at Leduc, Alberta, starting the western Canadian oil boom and blasting Mr. McMahon into the millionaire-class. With that, his convictions and his attempts to produce gas near Vancouver as early as the mid-1920's were handsomely justified.

DESCRIPTION OF PROJECT AT BEYNES

The French Treatment of Coke Oven Gas for Underground Storage

A DESCRIPTION of the underground storage project at Beynes was given at the meeting of the annual congress of the Association Technique de l'Industrie du Gaz de France at Bordeaux and was summarised in the 'GAS JOURNAL,' July 10. The following is a more detailed description of this project and includes an account of the purification plant, through which coke oven gas must be passed before it enters the underground storage to prevent contamination of the geological formation.

Intended for use as a reserve gasholder to meet peak winter demands in the Paris region and so to permit better balanced seasonal gas supplies to that region, a vast new aquiferous-structure underground reservoir has recently been brought into use by Gaz de France at Beynes, near Versailles, the use of which necessitates the treatment of the coke oven gas so stored.

Capable ultimately of containing 11,260 to 11,960 mill. cu.ft. of gas, of which about 5,300 mill. cu.ft. could be made available without the level of the water on which the gas rests rising to the foot of the shafts, the new reservoir will largely be effective in supplying the winter demand during cold spells, the porous and permeable sand and water bed having a usable length of 2.2 miles, a width of nearly 1¼ miles and a thickness of about 100 ft., with intercalation of benches of clay at different levels.

Second in World

Whereas many exhausted natural gas beds are being employed in the United States for storage purposes and some also in Poland, the French storage is believed to be only the second hitherto unused underground storage devoted to coke oven gas in the world, a similar reservoir having been established in Germany at Engelbostel, near Hanover. The presence in such coke oven gas, of polymerisable hydrocarbons which can form gums and other impurities complicates the problem of storing such gases since it is necessary to avoid any risk of damaging the shafts or polluting the underground water—dangers which do not apply to the storage of natural gas.

Gas feeding the underground reservoir comes either from the Alfortville coke ovens or from coking plants in the eastern region of France and is brought under pressure along a section of the Paris ring main to Viroflay whence it is brought at a pressure of 60 lb. per sq. in. by way of a new 26¼ miles long by 15¾ in. diameter steel pipeline to enter the reservoir at Beynes. When gas is withdrawn from the underground store, it is collected in a network of pipes which connect up the various shafts and is passed into the high-pressure Parisian ring main at Viroflay. A station has been constructed at Viroflay for distributing, regulating and reconditioning the gas. At Beynes, where the gas arrives at a pressure of 256 lb. per sq. in., a compression station has also been built for injecting the gas into the reservoir at a pressure slightly higher than the hydrostatic pressure. Here, too, there is a special station for treating the gas before injection, as well as a plant for dewatering the gas upon withdrawal after storage. Additionally, a number of ancillary services such as a boiler house, a laboratory, workshops, an office, etc., have been installed.

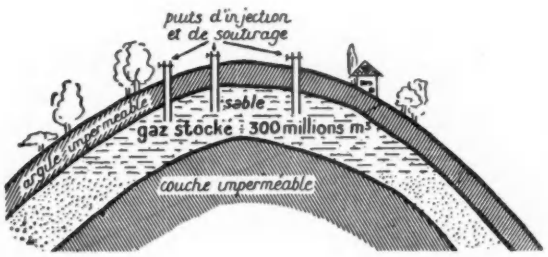
Although, normally, there should be no condensation in the Viroflay-Beynes pipeline during injection periods and withdrawn gas will have been passed through dehydrators, it has been protected on the inside against CO_2 corrosion in the presence of water by a cold application of epikote-resin-based varnish. The collecting network and the shaft tubes have been given three coatings of a hot polymerised epoxide resin paint.

At the entrance to the Beynes station a Blaw-Knox oil filter extracts any particles of dust picked up by the gas which might otherwise cause abrasion in the compressors. Thence the gas passes to the compressor room where three 400 H.P. compressors are installed. Because it was necessary to equip the Beynes station in the shortest possible time it was decided to use compressors belonging to the Régie Autonome des Pétroles which were then available at Peyrouzet, the natural gas installation near Pau. These Clark machines corresponded very closely to those required for Beynes except that, driven by gas engines, they were originally intended to run on natural gas and not coke oven gas. By increasing the inlet pressure to the engines through a modification of the setting of the throttle valve, the compressors were made to function on coke oven gas without appreciable loss of power. The plant is equipped with various safety devices covering the speed of the engines, the temperature of the cooling water, oil pressure and the temperature of the oil in cold weather. A special device controls the admission of gas to the engines in such a way as to limit the outlet pres-

View of pipeline installation at the Beynes underground storage project.

sure to 640 lb. per sq. in., the pressure at which the gas should enter the reservoir. Another device makes possible the regulation of the temperature of the gas in the purification plant in cold weather.

To provide gas compression of the order of 600 lb. per sq. in. the gas engines hourly consume 6,200 cu.ft. of coke oven gas and at a speed of 300 r.p.m. can compress 212,000 cu.ft. of gas per hour (15°C., 750 mm. Hg.). The oil filters located after the compressors are of the 'miofiltre' type and function as an improved Pelouze apparatus, their efficiency being absolute, at least when the gas is dry. An atmospheric cooling tower cools the gas after compression.



Diagrammatic representation of the Beynes underground storage system. Puits d'injection et de soutirage = *inlet and outlet mains;* sable = *sand;* gaz stocke—300 millions m^3 = *300 mill. cu. m. storage capacity;* couche imperméable = *impermeable bed;* argile imperméable = *impermeable clay.*

High Purity Needed

For the purpose of this underground storage system it has been necessary to achieve a degree of purification hitherto unrealised in the gas industry. This treatment to the gas before injection is to avoid damage to the porous sands in the reservoir by the chemical action between the sand, which is very fine with a contact surface of 3,380 sq. ft. per cu.ft., and the benzoles and heavy hydrocarbons, C_4 and C_5. To this end, the gas is passed through prefilters and absorbers charged with special active charcoal. There are two prefilters and six absorbers in all. The latter consist of long cylinders 9 ft. high by 5 ft. wide, fabricated of highly resistant steel plates.

The charcoal with which the absorbers are charged does not become exhausted by the effect of pressure and temperature. An initial charge of ten tons lasts for more than a year. Contact of the gas with the microporous and reactive charcoal sets up similar 'resinification' chemical chain reactions as would otherwise occur with the sand, thereby denaturing the gas before it enters the reservoir. The absorbers incorporate circuits for purging, drying, cooling, condensation, etc., while the plant installation includes a boiler house, an atmospheric cooling tower and various evacuation systems including those for gases from the purging process, polluted water and condensed hydrocarbons.

One prefilter and two absorbers work in series, while the rest at present are kept as standby. The prefilter relieves the gas of its naphthalene, its heavy fractions of benzole, its traces of ammonia and of sulphuric and cyanogen compounds, while the two absorbers extract from the gas what remains of the benzole and resinifiable hydrocarbons. When the first absorber has treated about 2.8 mill. cu.ft. of gas it is taken out of circuit and its active charcoal is regenerated by purging, while absorber No. 2 comes into first position and No. 3 is brought in from standby to take its place. The evacuated purge gases are burnt at a flare, while the liquid hydrocarbons are stocked for ultimate despatch to the refineries, and the polluted water is also collected in cisterns for ultimate delivery by truck to the water treatment plant. The gas remaining in the absorber taken out of service for carbon regeneration is de-compressed and driven by steam to a self-regulating gas boiler.

During its steam treatment, the charcoal becomes wet. This moisture is taken up by circulating gas through the absorber. The gas, after this moisture has been precipitated by cooling is reheated in a heat exchanger, and recirculated until the charcoal is dry. With the repeated passages of hot gas, the charcoal itself becomes hot and has to be finally cooled by a circuit of cold gas. This regeneration of the first-taker absorber is carried out after eight hours of working, but the prefilters last considerably longer and they need not be attended to until after they have treated 1,500 mill. cu.ft. of gas.

The treated gas leaving the absorbers may contain fine particles of active charcoal; it is, therefore, put through a filter packed with ceramic porous plugs which clears it of any dust. The gas is then metered in two large volumetric Delta 8 measurers, equipped with CDC temperature and pressure controls. This installation can also deal with the gas being withdrawn from the underground storage. When the station is fully working this metering equipment will be able to handle, if necessary, 1.4 mill. cu.ft. of gas an hour.

At Viroflay, the gas withdrawn from the underground storage is rebenzoled and rehumidified before being distributed to the high pressure ring main.

Gaz de France is not confining its investigations in this field solely to the Beynes project. The means of distributing natural gas, coke oven gas and refinery gas and the development of their production calls for the siting of new underground reservoirs. Investigations into other formations are being actively pursued in collaboration with the Services Géologiques de l'Institut Français de Pétrole.

Keyham Works to Close After 50 years

Coke Storage Depôt to Remain

YEARS-OLD 'FEUD' WITH HOUSEWIVES DRAWS TO CLOSE

NEXT April will see the closing down of the gasworks at Keyham. This works has been producing gas for its Devonport consumers for well over half-a-century.

This decision by the South Western Gas Board was reached, following a review of production activities. The coke storage depôt at the works will continue to function however.

Recently, Mr. P. G. Richardson, the Station Engineer, gave the news to the 120 employees of the depôt. Later, the Works Manager and Engineer, Mr. L. P. Price, said that the men had been told well in advance in order to give them an opportunity to find alternative employment.

He added that it had always been the policy of the South Western Gas Board to find alternative employment for long service employees—'In this case a large number of the 120 men who will become jobless next April will probably be absorbed at the Board's other works,' he stated.

For many years Keyham housewives have complained bitterly about soot and grime from the gasworks soiling their washing, and about three years ago the 'feud' between them and the Board reached boiling point. It was then that Mr. J. W. Dean, Plymouth General Manager, was approached on the matter.

This particular nuisance had also been used successfully in the rating appeals tribunal.

The Board has done everything possible to check the trouble and it has been partly successful; but although there has been less dirt, it has still continued to bother the local residents.

From a paper to the Wales and Mon. Junior Gas Association, October 16, 1957

Base Load Operation at Pontypool

By K. R. EDWARDS, M.Inst.Gas E.,

ASSISTANT STATION ENGINEER, PONTYPOOL, WALES GAS BOARD.

In 1934 the output of the Pontypool undertaking was approximately 120 mill. cu.ft. per annum, produced in a bench of stop ended horizontal retorts at Clarence Street Works, Pontypool. The year 1934 saw the beginning of a period of rapid expansion and integration of gas supplies and the trend still continues. The Blaenavon Company had ceased to manufacture iron, and only their coke ovens remained in operation. The Pontypool Gas and Water Company entered into an agreement to purchase supplies of gas from these coke ovens, and between 1934 and 1939 production plant at Blaenavon, Pontypool, Brynmawr and Blaina, Usk and Cwmbran were shut down and supplied with gas in bulk. The output of the Pontypool Gas and Water Company rose to 350 mill. cu.ft. per annum in 1939 as a result of this integration.

Rising demand brought about by expansion of industry, and increased prosperity in an area previously described as 'depressed,' made necessary the reconstruction and recommissioning of the Pontypool horizontal retort installation in 1940. By the end of the war, sales of gas had reached nearly 700 mill. cu.ft. per annum, and it was apparent that a new source of gas must be sought.

A total demand of 12 mill. cu.ft. per day was assumed as the maximum potential of the Pontypool undertaking and neighbouring undertakings it was likely to supply. The decision was taken to build a new production unit with a nominal capacity of 4 mill. cu.ft. per day of a gas of a calorific value of 450 B.Th.U. per cu.ft. carbonising Welsh coal. This works would be designed so as to meet the following requirements: (1) Good road and rail accesss, (2) suitably near N-S axis of the valley, to facilitate the most economic transfer of gas.

Extended Townships

The plant consisted of 36 82-in. Woodall-Duckham lambent heated retorts in two benches of 18 retorts, each bench heated by a battery of three step grate producers, joined by a common producer gas flue. It was opened in 1949, at a time when the townships being supplied had extended to Beaufort and Abercarn and up to 75% of the gas sent out from the Panteg works was at a pressure of 10 to 12 lb. per sq. in. The Pontypool Gas and Water Company considered forming a high pressure ring main though the Eastern and Western Valleys of Monmouthshire connected through Hafodyrynys in the south and Brynmawr in the north. The South Wales gas grid was at that time not in being, although the working party set up by the Ministry of Fuel and Power had formulated many proposals.

One of the many problems facing the newly formed Wales Gas Board upon nationalisation, was the future of Panteg works. It would become necessary to extend the carbonising plant further in order that retorts could be reset, unless a supply of gas was obtainable from an outside source. With the development of the South Wales grid (eastern section), and the gas supply negotiated by the Board with the N.C.B. from the Nantgarw coke ovens, further extensions were postponed, and a grid supply was introduced to Pontypool at Clarence Street works in December, 1951. This grid gas supply as recently modified, splits into two streams after passing through a volumetric governor. One stream passes into the high pressure system, thus reducing the load on the compressors at the Panteg works, and the other through a variable pressure set spill-over governor, into the low pressure system, the proportion of each depending on the grid terminal pressure at the inlet to the volumetric governor.

Following the extension of the South Wales gas grid (eastern section) into Brynmawr, Blaina, Beaufort, Abercarn and Tredegar, the Panteg works has been progressively relieved of supplying these undertakings, but Abergavenny remains bulk supplied from Pontypool. The Crickhowell and Brecon works will shortly be shut down and supplied from Panteg by means of a recompression station at Abergavenny.

From the outset, it was the intention that Panteg should carbonise coals from the Welsh coalfield, and principally those from the Eastern Valleys, which because of low freight rates are the cheapest. A study of the South Wales coalfield shows that it possesses coals varying from anthracite to medium volatile bituminous, though very few can be said to be good gas coals, and many are not suitable for use in continuous vertical retorts. Those from the Eastern Valleys of Monmouthshire are considered to be coking coals, of rank 301 with a swelling index of 6 to 8 and a volatile content of 27% to 30%.

Unlike the coals from the Midland and North Eastern coalfields, those from South Wales are either unscreened or else screened to large and 'through' coals. A large proportion of the coal carbonised at Panteg has been large which, when crushed, is similar to run-of-mine coal and has the effect of decreasing the capacity of the plant.

The first four years operation showed that some of the coals which appeared to be suitable for gas-making in fact possessed coke characteristics undesirable for producer operation. The adverse effect of these coals on combustion chamber temperatures, and consequent production, led to trials with anthracitic coals in the producers, but with limited success.

The declared C.V. at Pontypool of 450 B.Th.U. per cu.ft. remained until the introduction of grid gas led to standardisation at 475 B.Th.U. per cu.ft. Difficulty was first experienced in reducing the C.V. to the declared value. The high rank Monmouthshire coals were unreactive to steam, and could only be steamed down to a value approaching 450 B.Th.U. by reducing the throughput per retort to below seven tons per day. After extensive trials it was decided to instal a producer gas washer to enable producer gas, taken from the bus flue, to be used for dilution purposes. It has been found that when working at a throughput of eight tons per retort per day, and carbonising Eastern Valley coals, with optimum steaming, the minimum C.V. of the coal gas varies from 500 to 515 B.Th.U. per cu.ft. and dilution was necessary.

By operating the plant at a throughput of 7.0 tons per retort per day, a thermal yield of 77.0 therms per ton has been achieved with no producer gas dilution, which is in agreement with line five of West's steaming curves.

Less Reactive Coke

The coke produced by the carbonisation of Eastern Valley coals is much less reactive than the coke from the lower rank coals, and is at an obvious disadvantage in the domestic market, but very suitable for industrial use. Most of the coke sold from Pontypool is used for industrial and commercial purposes. The $\frac{5}{8}$ in.-$1\frac{1}{4}$ in. size is not much in demand, so this size is used for producer firing. With the present coal:coke ratio, the importance of coke today in the revenue account cannot be over-emphasised, and every attempt is made to produce the maximum amount of coke for sale. The average figure of coke for sale for the five years ending March 31, 1957, was 10.6 cwt. per ton of coal carbonised, plus 2.2 cwt. of breeze, and with the coal:coke price ratio at present at 0.755 Panteg is able to produce a therm of gas at a very favourable price.

With the plant operating under base load conditions, with a throughput of 8.5 tons per retort per day, the cost of manu-

facture at Panteg is as low as 6.0d. per therm, including capital charges. This may rise by as much as 2.0d. per therm if output has to be reduced by reducing throughput or by standing retorts. The Panteg works is, however, a part of the South Wales gas grid, and its operation must dovetail with the plans of the grid as a whole. If there is a surplus of gas within the system, and the grid is not taking sufficient from outside supplies to avoid incurring penalty payments it would be bad economy to maintain base load production. This position has occurred during the past two summers and consequently the possibility of maintaining the base load, and consuming the excess gas produced by underfiring producers with gas, and by benzole extraction has been considered. In the winter, the reverse position occurs. Demand for gas in the Pontypool district is then in excess of production. Experiments to increase production at such times by means of the 'Rochdale Process' of accelerated carbonisation have been carried out. Additional supplies of gas would otherwise have to be produced in C.W.G. plants, and it was thought that accelerated carbonisation must certainly result in a cheaper peak load therm than C.W.G., bearing in mind the price obtainable for coke. Trials of both processes were commenced in 1956.

While considerable work on accelerated carbonisation had been carried out by other area boards, and a commercial scale plant was in operation, it was required to establish how it would operate with the high rank coals carbonised at the Panteg works, and the degree of acceleration that could be attained. A severe winter in 1956-57 might have resulted in a shortage of gas within the grid system, and accelerated carbonisation could possibly have made the Pontypool undertaking independent of the grid if the need arose. Accordingly, eight retorts on A Bench were converted. The 'carrier' gas used was mainly coal gas, with up to 20% of producer gas added. It was realised that coal gas was not a desirable 'carrier,' but would serve to establish operating conditions. Producer gas was not available in large quantity, and in any case, without further enrichment, the volume of producer gas that could be used would be limited by the C.V. and characteristics of the resultant make gas.

Constant Pressure

A supply of unpurified coal gas was taken from the inlet purifier, was reduced in pressure to approximately 8 in. W.G. through a governor, and from thence to manifolds on each side of the retort extractors. A Roots type exhauster was installed to pull producer gas from the outlet of the producer gas dilution washer, and to deliver to the unpurified coal gas supply via a mixing box. This exhauster was hand controlled by adjustment of the steam supply to the prime mover, and provided that the volume of producer gas was always less than the total volume of 'carrier' gas, the coal gas governor would maintain the pressure in the system constant. A non-return valve was installed at the exhauster outlet to prevent coal gas from entering the producer gas mains. The producer gas and coal gas flows were metered and the total 'carrier' gas flow to each retort was regulated by means of a plug cock and a simple orifice plate with a manometer on each 3 in. inlet pipe. These manometers were calibrated against a rotameter on No. 18 retort. A steam purge was arranged to clear the extractor box and the 3 in. inlet pipe, and this was operated by means of a sliding interlock, which simultaneously shut off the 'carrier' gas, opened the steam purge and unlocked the extractor discharger wheel.

As a result of experience gained by the North Western Gas Board it was considered desirable to instal trunk feeds to the retorts in place of the usual coal deflector plates, in order to maintain steady coal travel at the higher throughputs. These were, however, not available in time for the experiments, and were in fact fitted later in the summer when the bench was shut down for repair.

The results obtained were inconclusive, but the following observations can be made:—

1. It is possible to reach a throughput of 12 tons per day (50% acceleration) though any higher than this is probably inadvisable. Specially careful technical control is necessary to maintain this throughput.

2. Retorts must be in sound condition before embarking on accelerated carbonisation. The retorts used had been reset two years previously, but the bottom firebrick zone had been in operation for seven years, and gas leakage was found to be a serious problem.

3. The simple pressure governed, mechanical interlocking plant is suitable for peak load operation, but care must be exercised to ensure that the apparatus and valves are sufficiently robust.

4. Coal travel is very erratic without trunk feeds.

5. Coal gas as a 'carrier' leads to excessive scurf formation, which by halving the period between scurfing, may nullify the extra gas production obtained, unless the period of operation on accelerated carbonisation is a short one to meet seasonal peak demands.

6. Where B.W.G. is not available, producer gas is the ideal 'carrier' gas, but its use is limited unless some form of enrichment is used. Where the producer gas is derived from the setting producer battery, sufficient producer gas may not be available to meet all commitments and in any case automatic pressure and blast saturation control must be fitted to maintain constant volume and quality.

7. When carbonising high rank coals, some undercarbonising may be unavoidable, and undercarbonised coke may lead to difficulties with producer operation.

The opportunity was taken last summer to convert the remaining ten retorts on A Bench for accelerated carbonisation, and to cold patch the retorts. Difficulty had been experienced in passing sufficient producer gas through the existing producer gas washing plant, so two old C.W.G. washer/sealpots were erected adjacent to the retort house, and a supply of producer gas taken off the north end of A Bench flue, to make the producer gas 'carrier' system independent of the dilution system. The winter of 1956-57 proved to be an exceptionally mild one, and it was therefore not necessary to practice accelerated carbonisation.

During the winter of 1956-57, the retort throughput on both benches was increased to determine the maximum practical throughput possible under normal carbonising conditions. It was raised to a maximum of 8.9 tons per retort per day, with an average of 8.75 tons during the months of January and February, 1957. At 8.9 tons per day, coke was decidedly undercarbonised despite the highest safe temperatures, and the retort house atmosphere during retort discharging was very bad, due to smoke and dust emission. Volatile matter in the coke rose from an average of 0.7% at 8.0 tons per day, to approximately 1.4% at 8.9 tons per day, and thermal yield dropped from 71.0 therms per ton to below 69.0 therms per ton. Output from the plant however rose to a maximum of 28,017 mill. cu.ft. in the week ending February 9, 1957, the highest output ever achieved. This represents the normal output with 32 retorts at work and four retorts scurfing, and had it not been necessary to 'stand' retorts at the week-end through inadequate demand, the output for the week could have been 28.5 mill. cu.ft. These high outputs were accompanied by an extremely low cost of production per therm. Producer cleaning conditions became more arduous as a result of the greater load and undercarbonised coke. Dilution producer gas was sometimes in short supply, due to the limiting capacity of the washing plant and the amount of exhauster 'pull' required to draw away the producer gas. In order to maintain the retort temperatures, which were increased to 1,360° to 1,380°C., at the second pass, the producer venturi discs were removed and the jets withdrawn until they were in line with the venturi entrance.

Tarrier Conditions

The A Bench retorts were in operation with trunk feeds, which resulted in better coal travel conditions. Their use has caused much tarrier conditions at the offtakes, the reverse of what one might have expected in view of the larger cracking space. It is not possible to separate the two benches, so no comparative results are available.

The use of coal gas for heating retort settings has been the subject of considerable attention in the past four years although the very thought would have shocked many of the past generation of gas engineers. Its use is thought to be justified by the rising demand for gas coke, and the enhanced value of that product. Producer gas derived from coke can be shown, under certain conditions, to be dearer than coal gas. The use of partial coal gas firing of retort settings, would permit a larger proportion of carbonising plant capacity to be utilised

than is at present the case, as for instance in areas where bulk supplies of coke oven gas are taken, and where isolated plant is too large for its gas commitments. In the latter case, it will probably be more economic to produce the coke on the spot than to import it from other works.

In coke oven practice, many installations are built for dual firing with either coal gas or producer gas, with the producer gas generated in mechanical producers forming a completely separate installation. The coal gas or producer gas is usually fed directly to the combustion chambers through calibrated jets, whereas gasworks carbonising plants are designed specifically for the use of hot producer gas, and control is by means of sliding dampers; therefore the substitution of coal gas for producer gas directly to the settings is not practicable, and the coal gas must be introduced into the producer. Introduction of coal gas to the producer results in a lowering of the fuel bed temperature, and this is the limiting factor. Experience elsewhere suggests that the maximum percentage of coal gas it is possible to inject lies between 25% and 40% of the total thermal input to the producers. The technique consists of admitting the supply of coal gas to the producer just above the door lintel, and may be accompanied by bricking up the top plates of the step grate.

At Panteg works, a 6 in. supply was taken off the same unpurified gas supply that was used for accelerated carbonisation, through a governor, and a B-M meter to a 3 in. manifold in front of the producers. Two 1½ in. supplies feed the large producers, and one 2 in. supply feeds the small producers. The supply is introduced to the producer through the 9 in. by 6 in. loose brick. Gas flow is regulated by means of a plug cock on the 2 in. supply to each producer, and controlled by a simple orifice plate meter with manometer. Partial coal gas firing began on B Bench in the summer of 1956, and continued until September, when it was discontinued to meet the increased demand for gas. The volume of coal gas was increased steadily until a maximum of 12,000 cu.ft. per hour was attained, and maintained at this volume for a fortnight. This was equal to 25% of the total heat input of the setting. The fuel to producers is always accurately weighed, so normal fuel consumption is accurately known. To obtain an accurate thermal equivalent of gas to coke, it is necessary to know what the total coke consumption would have been under normal producer operating conditions. Variations in retort throughput and the number of retorts at work can have a considerable effect on the fuel consumption, and it is unfortunate that at this time we were reducing throughput and standing retorts to meet the reduced gas grid demand. Conditions were maintained steady for two weeks after the cessation of partial coal gas firing, and these figures were used to compare with the last two weeks of partial coal gas firing.

No Difficulties

The Panteg producers are of the standard Woodall-Duckham pressurised type and gas leakage might be expected to be higher than that obtained with the natural draught type of producer. The size of fuel too would be expected to have an effect on the efficiency of the process. No operational difficulties were encountered. Retort producer gas dampers were adjusted as required, and the heating gas flue pressure was decreased to level gauge. The producer venturis were adjusted to increase the proportion of air to steam in order to maintain the fuel bed temperature, and fire cleaning was reduced from 8-hour cleaning to 12-hour cleaning. The coal gas was left on all the time, but the producer steam was checked for fire charging to reduce the amount of flame.

The 1956 tests indicated that partial coal gas firing was a feasible proposition. This year the A Bench producers were converted for partial coal gas firing, and the B-M meter replaced by a Connersville meter of larger capacity. Partial coal gas firing was commenced in June and continued until mid-September. The volume of gas was increased fairly rapidly to 18,000 cu.ft. per hour, and remained steady at 16,000 cu.ft. per hour or 384,000 cu.ft. per day for the rest of the summer. Larger volumes might have been used, but for the leakage at the producer charging lids, and the bad atmosphere caused by the slight leakage of unpurified gas.

Factors effecting the thermal equivalent of gas to coke may be said to be: (1) The degree to which partial coal gas firing is practised, (2) the normal efficiency of the producer when operating on coke, (3) the type of producer, i.e.—whether forced draught or natural draught, (4) the load on the producer in relation to its grate area, (5) the extent of gas leakage, (6) frequency of fire cleaning and carbon loss in ashes, and (7) size of fuel.

Experience with partial coal gas firing and accelerated carbonisation emphasizes the need for greater flexibility in producer operation, and steps have been taken at Panteg to equip the producer battery with forced draught fans in place of the steam blown venturis, and pressure and blast saturation control. A thermal equivalent of 171 therms of gas per ton of coke has been stated to have been achieved on another installation. The equivalent is certainly much less than the straight equivalent of 280 therms per ton and the actual figure will depend on the factors previously stated.

Costs of partial coal gas firing are based on a works with a capacity of 3.84 mill. cu.ft. per day at a retort throughput of eight tons per day, which is required to reduce its output to 3.36 mill. cu.ft. per day.

In the paper three examples of how reductions may be made and how this influences the costs of production are given.

In example 1 it is assumed that the plant is base loaded at eight tons per retort per day, and 480,000 cu.ft. per day of coal gas is used for firing producers. In example 2 it is assumed that four retorts are stood, and no coal gas is used for firing producers. In example 3, the retort throughput is reduced to 6.5 tons per day, and the retorts 'steamed' to produce gas of 475 B.Th.U. per cu.ft. without producer gas dilution.

Cost of production in examples 2 and 3 are approximately the same, but example 1 shows a saving over 2 and 3 of £66 per day.

Naphthalene Content

Obviously where coke oven gas is purchased at a differing price from that made, or where failure to purchase a given contract quantity involves the payment of a penalty, the economic position becomes more favourable to the use of partial coal gas firing. The ability to sell the additional coke, being a major factor, requires consideration. At an equivalent of 200 therms of coal gas to a ton of coke, and coke realising £6 16s. per ton, the equivalent price of gas is 8.16d. per therm.

With the laying of the 3 in. main from Abergavenny to Brecon, which will operate at a pressure up to 100 lb. per sq. in., the need to reduce the naphthalene content in the gas to be compressed is imperative. Most of the gas distributed in South Wales is purchased from coke ovens, which generally wash the gas for benzole, and in the process reduce the naphthalene content to a very low figure. The gas produced at Panteg has not been benzole washed, and contains up to seven grains per 100 cu.ft. of naphthalene. This causes no trouble with gas distributed at low and medium pressures, but could be the cause of serious trouble when operating at 100 lb. per sq. in. Consideration has been given to the installation of a benzole plant at Panteg rather than the construction of a naphthalene washer at Abergavenny.

It has been stated earlier that the undiluted coal gas at Panteg has a C.V. of from 500 to 515 B.Th.U. per cu.ft. and steaming to 475 B.Th.U. per cu.ft. is impossible without reducing the throughput to an uneconomic figure. If one assumes that the recovery of 2¼ gal. of benzole per ton of coal will reduce the C.V. by 20 to 25 B.Th.U. per cu.ft., it is apparent that benzole extraction to this extent may be carried out with no alteration to the plant other than some reduction in producer gas dilution. No extra coal will be required, and the only additional coke produced will be that displaced by the reduction in producer gas dilution, amounting in this case to a saving of approximately 1½ tons per day. Adequate low pressure steam is available which at present has to be blown to waste.

A major advantage of a benzole recovery plant at the Panteg works is that it will act as an additional large gas consumer, which can be shut down when the necessity arises. The principal expenditure will be the purchase of gas from the coke ovens, which will cost considerably less than the revenue received from the benzole recovered. It is likely that benzole extraction will only be practised for nine months of the year, and the plant operated as a naphthalene washer during the winter months.

For peak load purposes, say periods not exceeding one week, it would appear quite practical to re-evaporate benzole into the gas, adjusting the C.V. by means of increased producer gas dilution. The restricting factor would be the variation in gas combustion characteristics. The gas from Panteg has a specific gravity of 0.40 to 0.42, and it appears that this could be increased somewhat without causing a great deal of inconvenience. Assuming that the extraction of 2¼ gal. of benzole per ton of coal would reduce the output by 240,000 cu.ft. of gas per day, at 475 B.Th.U. per cu.ft., the reverse could apply and the re-evaporation of 576 gal. of benzole per day would be accompanied by an increase of 240,000 cu.ft. of gas production.

We can now consider five stages of operation while still maintaining the plant at an economic load.

1. Peak day 8.5 tons per retort per day. No benzole extraction, re-evaporating 576 gal. of benzole per day. Production 4.24 mill. cu.ft. per day, equal to 29.68 mill. cu.ft. per week.

2. Normal winter, 8.5 tons per retort per day. No benzole extraction. Production 4 mill. cu.ft. per day, equal to 28 mill. cu.ft. per week.

3. Nominal 8.0 tons per retort per day. No benzole extraction. Production 3.84 mill. cu.ft. per day, equal to 26.9 mill. cu.ft. per week.

4. Normal summer, 8.0 tons per retort per day. Extracting 2¼ gal. of benzole per ton. Production 3.6 mill. cu.ft. per day, equal to 25.2 mill. cu.ft. per week.

5. Minimum summer, 8.0 tons per retort per day. Extracting 2¼ gal. of benzole per ton, and partial coal gas firing 400,000 cu.ft. per day. Production 3.2 mill. cu.ft. per day, equal to 22.4 mill. cu.ft. per week.

In 1957, the weekly output to the Pontypool area of supply has only fallen below 22.4 mill. cu.ft. for three weeks at Whitsun and August, so with partial coal gas firing and benzole extraction, it should theoretically be only necessary to 'stand' retorts, or lower throughputs, for three weeks of the year, whilst maintaining a throughput of 8.0 tons per retort per day, with an average of 32 retorts working. It is apparent from this that the coke market must be expanded to make full use of the possibilities of the plant.

As a result of the need to distribute dry gas, it is proposed to instal aftercoolers to shock cool the high pressure gas after compression, and a partial dehydration plant to dry the remaining low pressure gas, the latter to be sited on the holder outlet main.

Works water requirements are obtained from the Pontypool town supply, and amounts at the present time to approximately 1 mill. gal. per week representing an expenditure of nearly £4,000 per year. The demand for water will increase, as further water will be required for cooling purposes for the concentrated liquor plant, benzole plant, gas dehydration plant, aftercoolers and a new electric compressor, possibly to the extent of another 1 mill. gal. per week, and this demand can only be met economically by the installation of a water cooling tower and recirculation system. This water cooler will be mounted over a concrete sump with one hour's water capacity—a necessary safeguard in view of the works dependence on water from a source outside its control.

DISCUSSION

Mr. J. M. Westcott (Monmouthshire) asked for Mr. Edwards' observations on the effects of accelerated carbonisation on the refractory itself.

Mr. Edwards replied that the period of accelerated carbonisation was limited. No effect had been noted on the refractories but there was a danger of leakage in the firebrick zone. 'We had some fairly serious trouble there,' he said, 'but of course it is not desirable to operate with coal gas because of the heavy scurf formation. We did notice that large slabs of refractory were coming away with it.'

Mr. H. F. Whitcombe (Newport) queried whether he had worked to the limit at the high retort temperature of 1,380°C.

Mr. Edwards replied: 'We did not work such high temperatures on actual carbonisation but only on the accelerated throughput last winter. Our normal temperature is 1,360°C., but even at 1,380°C. we could not guarantee no undercarbonisation due to the treacherous travel of the coal.'

Mr. V. Sutherland (Cardiff H.Q.) noted that no mention had been made of tar production, and also asked what amounts of steam were used in the prime movers.

Mr. Edwards said it was unfortunate that the works had been designed for much bigger operations, and it was intended that electricity should be generated at the works. 'We seem to have gone a bit adrift,' he went on, 'because we cannot use all our waste steam. There will be a use for it when we get our benzole plant. Our tar production is quite low at 10 gal. per ton of coal carbonised due to the low volatile Welsh coals we use. We cannot use breeze because the producers were not designed for operation with breeze, and what we call breeze is practically dust. Anything less than ⅝ in. would be useless for producer operation.'

Mr. P. C. Foster (Swansea) noted with surprise that no mention was made on page 11 of the paper about carrier gas and carbonisation, and asked whether accelerated carbonisation had been 'written off' or whether it was considered that producer gas could be used to a very limited degree only. He also asked whether they had considered utilising Tully gas as a carrier gas.

Not Written Off

Replying, **Mr. Edwards** said accelerated carbonisation had not been written off, but added that they had never been happy about the process. 'I would say,' he continued, 'that we would not consider operating accelerated carbonisation except in serious circumstances, and that is a question of policy by the Board. I agree that our coal gas is not an ideal carrier, and unless we have some form of carrier gas the process is probably not an attractive one. The question did arise of installing a B.W.G. plant, but one was not available, and again I am not certain if we would be permitted to install either a B.W.G. or a C.W.G. plant at Panteg. There was quite a fight to get the works sited at Panteg at all, and there might be local objections to a C.W.G. plant.'

Mr. Reeve (Board H.Q., Cardiff) said: 'The Board realise that the experimental period of accelerated carbonisation was a success. It was done purely as an experiment and it would be done again should the need arise.' Expressing his interest in the thermal replacement of coke by gas, Mr. Reeve said it seemed extraordinary that coke could be replaced by thermal gas, and asked whether it would have been the same had Pontypool been using run of retort coke.

Mr. Edwards said that this would not be so, because there would be a loss of carbon in ashes due to the small coke used. On thermal values, he said a lot of argument was going on at present concerning the actual equivalent of gas and coke therms. 'We did not find it easy to arrive at a definite equivalent owing to the alterations to the plant during the summer," he said. 'It does seem, however, that 200 therms per ton is a reasonable figure to take.'

Mr. W. E. Whitney (Newport) wanted to know whether there was any difficulty in maintaining correct temperatures when using coal gas for firing, and whether it was considered that one hour's water supply at the works was sufficient.

Mr. Edwards said water was obtained from the town supply. Another pipe had been put in on the opposite side of the works in order to ensure that should one supply fail another would be immediately available. 'But,' he warned, 'if Pontypool is going to be short of water we are going to be short as well.' On maintaining temperatures, Mr. Edwards said that there had been an immediate outcry that the tops were hot when they turned over to partial coal gas firing. 'You must be careful that people do not anticipate changes when none in fact take place,' he added.

Mr. A. G. Saunders (Board H.Q., Cardiff) said the paper helped people to appreciate the distribution problems of the grid. 'We have to provide sufficient gas for our winter requirements without having too much gas for our summer's requirements,' he stated. 'In his conclusion Mr. Edwards did state that the optimum load could be successfully maintained for all but a few weeks of the year. In those few weeks it is going to be difficult to reduce the gas. In order to reduce on our winter supplies we have purchased further supplies from the N.C.B. coke ovens which will be coming into operation shortly. We shall have 4.25 mill. cu.ft. per day which will be flexible. The main difficulty is, in my opinion, the surplus of gas we have had in the summer. When we consider the economics of gas production in the whole of the grid area we have to look at it not just on thermal efficiency of, for instance, just your plant, but the grid system makes us look on things in a more communal manner. We have

to choose the gas we are going to distribute, considering the contracts we have made with different supplies of gas, compared with the Pontypool production difficulties.'

Mr. Edwards replied that it seemed fairly obvious that the last speaker would like them to close down altogether in the summer, but he was afraid they could not oblige him to that extent.

Mr. S. D. Coole (Barry) praised the paper as one of the best he had listened to for a long time. It seemed to him that acceleration was tried simply for obtaining information. Referring to the dust burning equipment in the boilers he said that from his experience they could get out of alignment and do a lot of damage to brick work.

Mr. Edwards said the equipment was fixed inside the boilers and he did not think it would wander about inside.

Another question from **Mr. Reeve** was, what effect benzole extraction and evaporation had on sulphur content of the gas. 'A marked interest is being shown in the sulphur content of gas at present,' he said, 'and I would like to know what effect this is going to have, and if in fact the practice of evaporating benzole is put into operation what effect this is going to have on putting the sulphur back again.'

Mr. Edwards: 'I only mentioned this to meet peak periods of say one week, so I do not think the effects are going to be adverse so far as sulphur content is concerned. I think that benzole can be defronted if it is thought to be necessary.'

From a paper to a joint meeting of the Midland Junior Gas Association and the Wolverhampton & District Engineering Society.

Development and Use of the Lubricated Taper Plug Valve

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BASICALLY, the plug valve is the simplest of all types of pipeline isolator and it is natural therefore to find its origin far back in history. For example, in ancient times simple plug cocks were employed for piping water on small service mains from open aqueducts and similar types were used for many centuries. There are examples of timber water mains laid in London as late as the 17th and 18th Centuries employing simple cocks of the same type. The fundamental design has the inherent advantages that when open it offers a smooth passageway to flow and none of the working surfaces are exposed to the line fluid.

The plug cock became a plug valve with the advent of lubricant. The inventor was a Mr. S. J. Nordstrom, a Swedish engineer designing and operating cyanide plants in the Mexican mines, where serious difficulties were being encountered with all types of valves handling cyanide solutions and slimes. His invention, by employing Pascal's Law covering the transference of hydraulic pressure, enabled the plug to be jacked off its seat and lubricant to be distributed over the taper surfaces by smear action without dismantling the valve. Lubricant sealing was to come a little later.

Mastic Sticks

This work on port sealing by lubricant was done by an Englishman, Mr. R. W. Leach, who met Nordstrom and his associates in South Africa and America. These early efforts gave rise to the plug valve which we know today and which is known in America as the Nordstrom and in Europe as the Audco lubricated taper plug valve.

The lubricant is quite unlike ordinary mineral or vegetable oil based greases. It is compounded into mastic sticks that have a fibrous feel and are extremely adhesive. It is fed into the valve either by pressure screw or by Tecalemit type lubricant gun. With pressure screw lubricated valves, the lubricant is inserted by removing the pressure screw from the valve stem head and pushing a stick of lubricant into the lubricant reservoir, replacing the screw to provide pressure. By a system of drilled ducts lubricant is forced down the plug stem to radial holes connected to a peripheral groove cut in the upper part of the taper plug. This peripheral groove connects with four equally disposed pockets in the body casting. When the valve is in the fully open or fully closed positions and for a small angular movement each side of these positions, the pockets give a register between the upper circumferential groove and four longitudinal grooves milled down the face of the plug. The bottom end of these grooves register with similar pockets near the base of the body.

Thus, in either fully open or fully closed positions, there is a direct channel from lubricant screw to the chamber beneath the base of the plug, enabling the system to be completely filled with lubricant and the valve ports sealed round their periphery with a complete circle of lubricant.

By tightening the lubricant screw, pressure is built up to give a seal. Further screwing builds up pressure in the chamber beneath the plug to free a tight valve by easing the plug in its seat. The pockets in the valve body are arranged so that the longitudinal grooves in the plug lose register just before they are exposed at the valve ports. Thus, loss of lubricant and loss of pressure into the pipeline is prevented. During manufacture body and plug are lapped together to a perfect fit and the lubricant film is less than one thousandth of an inch in thickness.

To summarise, the advantages claimed are: (1) There are no working surfaces exposed while the valve is open, (2) there are no pockets into which sediment and dirt can lodge, (3) the lubricant film protects against corrosion and scale forming in the closed position, and gives a positive seal, and (4) the jacking action can be brought into use on difficult services.

From the beginning it was evident that ordinary commercial greases would not fulfil the taper plug valve's requirements which are essentially: (1) An ability to adhere to metallic surfaces in a tacky form yet with sufficient fluidity to flow through the valve ducts, (2) good chemical resistance to the line fluid, (3) proper performance at extremes of temperature, and (4) reasonable lubricating properties to give easy turning of the valve.

Multi-purpose

Until recent years, there was a tendency for individual chemical services to need their own particular lubricants. This involved plant maintenance staff in carrying diverse stocks of lubricant with possible confusion of application. As industry became more complex the need for multi-purpose lubricants became greater and much research work was done with this in mind.

Valves, nowadays, are available in a wide range of metals, cast iron, carbon and alloy steels, stainless steel, etc.; in sizes from ¼-in. to 24-in. bore, and in pressures up to many

thousands of pounds per square inch. They are made in three basic types, all of which can be lubricated and adjusted while in service under pipeline pressure. Straight-through and multi-port forms are available.

The first type of valve produced was the 'standard' type, which is still very popular today. The plug and stem are integral with each other, the stem being attached to the large end of the plug. The bottom of the valve body is solid and the plug therefore sits in the body with its small end pointing downwards. The gland is at the large end of the plug and serves both as the thrust means to hold the plug on its taper seat in the body and also as a final precautionary seal to the stem.

In the 'inverted' type of valve the plug and stem are still integral but the stem is attached to the small end of the plug, and the plug is inserted into the body through a cover plate in the base of the body at the large end. This cover plate incorporates a device to produce thrust adjustment to hold the plug on its seat. The gland is located at the small end and is used solely to seal the stem to maintain lubricant pressure at its point of exit from the body. This type of valve has advantages for frequently operated services as it will remain in thrust adjustment indefinitely. The turning effort is much reduced because the gland does not have to provide thrust, and this is of particular advantage in the larger sizes.

The 'hypreseal' type is a development of the inverted type valve for high pressure work up to 6,000 lb. per sq. in. gauge or in special cases even 10,000 lb. per sq. in. gauge. The stem, which is separated from the plug (the conventional gland is completely discarded) and screwed into the body and the gland sealing is effected by injecting a special mastic compound into the thread labyrinth. The connection between stem and plug is by Oldham's coupling to accommodate the small endwise movement of the stem in the threads during rotation. The stem sealing compound differs from the plug lubricant, being formulated specifically as a sealing medium producing a minimum turning effort.

The success of the plug valve has caused a progressively increasing demand for a diverse range of operating means, and in addition to the normal method of hand wrench operation the following mechanisms are now available: (a) Hand operated gear units for the larger valves (including water tight versions) with extension columns in any desired plane, (b) intercoupling linkages suitable for both wrench and gear operated valves, and (c) interfering discs to give sequence control on a pair of valves so that one selected valve must always be operated before the other.

Today, engineers are finding it more and more convenient and indeed necessary to use power operated valves, using either pneumatic or electrical means of operation. The pneumatic operator is complete in itself, totally enclosed, and incorporates a double acting cylinder which operates the valve plug through a rack and quadrant. Limit switches may be fitted for relaying sequencing back to a control panel. The movement of all pneumatically operated valves can be initiated by either pneumatic, hydraulic or electrical means through suitable relays from a remote point.

Electrical operation is by electric motor driving through an integrally mounted gear unit. Both hammer blow and automatic torque limiting devices are included, which, though apparently contradictory, are in fact complementary. Valve operating times vary between about 15 seconds for small valves up to about one minute for larger valves. Flameproof specifications are available.

'Cold Stitching' Gasworks Retort and Main

TO avoid cutting off gas supplies when maintenance work is being carried out on mains, pipes, or gasholders, it must be done either during off-peak periods or, if this is not possible, while the gas is flowing. This, of course, poses many problems.

Two interesting repairs were recently carried out in Devonport, one at the gas production plant, and the second under rather more difficult conditions by virtue of the inflammable atmosphere on a fractured gas main under George Street.

At the Devonport gasworks the horizontal retorts are cast with iron lugs, and one of these lugs snapped off when it came into contact with the loading machinery. Metalock (Britain) Ltd., were called in to survey the damage, and a repair was carried out in the following manner.

The portion of casting from which the lug had been severed was squared up, and a lug from an old retort was fastened into position. The method of joining together the two pieces of cast iron is comparable to a medical suture, a number of metal stitches being inserted across the joint, each stitch comprising a row of holes with channels cut between them, into which the bonding metal is inserted. Using a jig for correct spacing and alignment, blind pilot holes were drilled in the parent metal and the new lug in a line transverse to the joint—in the manner that surgical stitches cross an incision. These pilot holes were opened out and the metal between adjacent holes removed with a gun tool, leaving parallel rows of interconnecting holes.

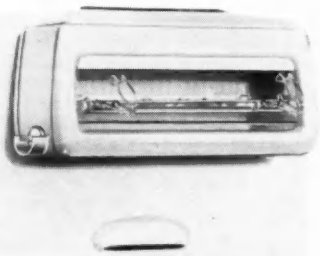
Metal stitches in the George Street, Devonport, gas main.

Into each channel was driven a succession of Metalock 'keys' made from a specially prepared, highly ductile alloy of great tensile strength with a temperature coefficient similar to that of the parent metal and shaped to fit the cavity exactly. After driving them into position with a pneumatic hammer the keys were subsequently peened so that they were part of both parent metal and the new lug. Further strength was then added to the repair by using the 'metalace' process. This consisted of drilling tangential holes along the actual line of the joint, the holes being tapped to receive studs of the same metallurgical characteristics as the keys. As in the case of the keys, the studs were peened. This process of peening studs into the line of the joint ensured that the two sections of metal were completely integrated.

The fractured gas main in George Street manifested itself while Metalock engineers were working at the gasworks. A fracture 9 ft. 9 in. in length appeared in a 30-in. cast iron pipe with 1-in. walls, but the position of the fracture, on the underside of the pipe, made the repair more difficult. A naked flame was, of course, impossible in such an inflammable atmosphere and therefore the Metalock cold repair process was again brought into operation, with out shutting off the supply of gas.

Holes were drilled on either side of the fracture and keys were inserted in the pipe in the same manner as that used for the fractured lug. To add further strength studs were inserted along the line of the fracture and both keys and studs were peened. Altogether 452 keys were inserted in the casting to stitch the two sides together, and complete integration was achieved by driving in and peening 400 studs along the fracture.

NEW WORLD RANGETTE



Only 32½″ wide. De Luxe—but reasonably inexpensive. Four self-lighting, Radoflex boiling burners with Safety Taps giving an unusually flexible control of burner heat. Comfort-Level Grill in centre of splashplate—visible, accessible, convenient and closable. Hotplate with deep, smooth, spillage collection bowls. Large, new Regulo-controlled oven with easy-clean interior. Warming Chamber of generous size fitted with rack. Useful full-width utensil storage compartment with drop-down door. Fits flush to the wall.

Colours—White or Cream.

Overall Height 47″ Width 32½″ Depth 22½″

NEW WORLD NINETY

A robust, large-capacity cooker intended primarily for small hotels, cafes and boarding houses. Also suited for domestic purposes in the larger household. Comprises a large Regulo-controlled oven with double doors, a spacious but simply designed hotplate incorporating six Radoflex boiling burners with safety taps and a dual Eye-Level Grill. Fits close to the wall.

Colours—White or Cream. Overall Height 61″ Width 30½″ Depth 28″

From a paper to the Autumn Research Meeting

The Kinetics of Coal Carbonisation

By D. FITZGERALD, M.A., B.Sc.,
ARTHUR DUCKHAM RESEARCH FELLOW.

EARLIER studies of the kinetics of coal carbonisation, in which the change in weight is used as a parameter for following the reaction, are considered and shown to give information concerned mainly with the evolution of tar, so that other methods are needed for the study of the evolution of the remainder of the volatile materials. The method adopted is the determination of the flow rate of each of the gases concerned under vacuum at rising temperature by measuring the flow rates of all the gases, and frequent analysis.

In the study of the kinetics of a chemical reaction, the change in molar concentration of one of the reacting species is normally measured, because this parameter is proportional to the number of molecules of the species present at any instant. The changes in weight of the reactant and the products are not immediately relevant, but, if the nature of a reaction product remains constant throughout the reaction, the weight can of course be used. With the decomposition of coal this is not so, as initially the product is mainly tar, while finally it is almost entirely hydrogen.

More Important

In terms of numbers of molecules, the gases and water are vastly more important than the tars, but the latter are the most important in terms of weight in the early stages of the pyrolysis. Thus the gravimetric kinetics of coal are mainly concerned with the tars, and can be accepted on the assumption that they all have the same molecular weight, at least to a first approximation, or else that the activation energies of the various reactions are the same. Indeed, this is confirmed by the fact that the theory and experiment do not agree at temperatures higher than about 500°C., making it necessary for van Krevelen and co-workers, as well as Boyer, to propose 'secondary degasification,' to account for the discrepancy.

In the study of the reactions producing the various gases not condensible at room temperature, the theoretical difficulties encountered in interpreting the results of the gravimetric method can be avoided by using the flow rate of the non-condensible gases as parameter for following the course of the reaction. By analysing gas samples taken frequently, a curve relating flow rate to time or temperature can be drawn for each of the individual gases, so that the carbonisation reactions can be studied for each gas separately. This method was used in the present work. Form the results, far reaching conclusions are drawn on the nature of the carbonisation reaction. Deductions on the structure of coal are also made, which agree well with other work (van Krevelen and Schuyer, Hirsch).

Turning to the apparatus used (see Fig. 1), the decomposition took place in a fused silica tube of 17 mm. internal diameter, one end of which was placed in the furnace. At that end there was a thermocouple pocket which was completely within the coal during an experiment. To this end of the tube, helium could be supplied to flush the apparatus. The reaction tube was evacuated by a 'Sigma' pump, which consists of a series of parallel bars pressing in turn upon a piece of flexible thick-walled tubing, thereby urging the gas within in one direction. The pump achieved a vacuum of about 10 mm. Hg abs., the exact value depending on the condition of the tube. The pumping rate was sufficient to ensure that, with coal samples of the order of 3 g., the pressure never rose above about 20 mm. Hg abs., even when the flow rate was greatest.

This relatively inefficient pump was chosen for the work as it ensures that the gases pumped cannot be influenced by the oil used to lubricate the pump, as would have been the case in a pump with pistons, or in a rotary oil pump. Between the pump and the reaction tube was a condenser immersed in ice to remove the tar and water formed. Beyond the pump, there was a hydrogen sulphide absorption tube, the sampling-point, and a mercury manometer of special design. Provision was made for purging the portion of the apparatus on the high-pressure side of the pump with helium, while at the same time allowing the flow from the pump to escape to the atmosphere.

Pressure Increase

The method of flow measurement adopted was to prevent the exit of gas from the apparatus for known periods, and to measure the resultant pressure increase in the system, of which the volume was known. This was done by stretching a fine platinum wire in the rising limb of the manometer, and making this wire one arm of a Wheatstone bridge, which was balanced with no excess pressure in the system. The other arms of the bridge were such that the out-of-balance voltage caused by a pressure rise in the system is proportional to that pressure rise. The out-of-balance voltage was recorded on a Honeywell-Brown recorder.

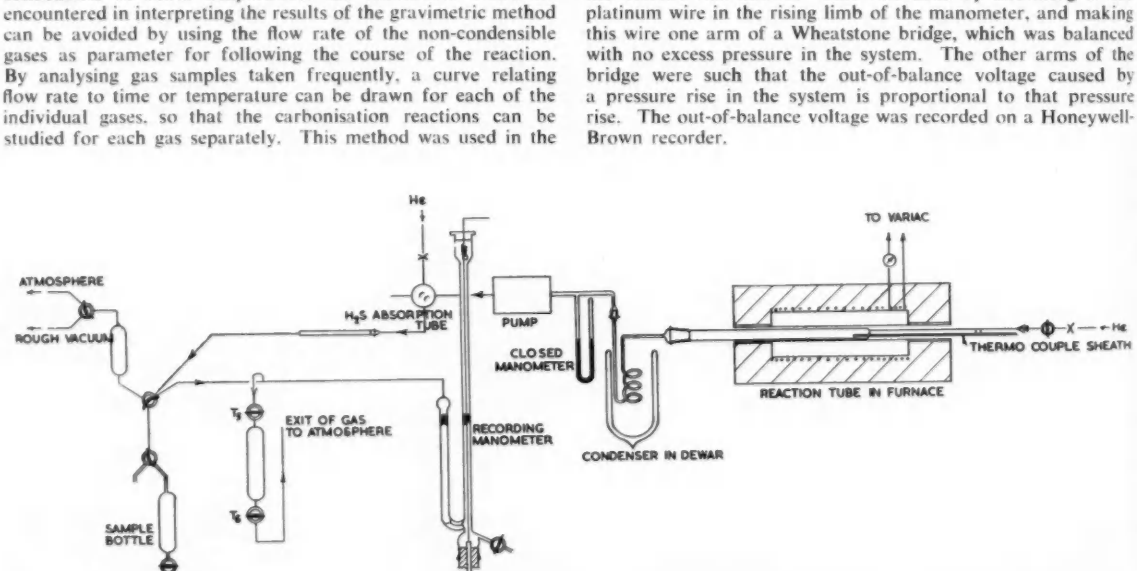


Fig. 1. Apparatus used. Thin lines represent 1 mm. dia. capillary tube. Arrow heads indicate direction of gas flow when no sample is being taken.

The furnace consisted of a steel block 25 cm. long by 8 cm. diameter, with an axial hole to take the reaction tube. The block had a 1.5 kW winding, which allowed heating rates up to about 6°C. per minute. Owing to the high thermal capacity of the furnace, linear heating rates could be achieved with a minimum of attention, using a variable transformer without an automatic controller. Normally, a heating rate of 1.80°C. per minute was used, and this was obtained to ±0.02°C. per minute, that is to say, the range from 300°C. to 700°C. was covered in a period of 220 to 224 minutes. An experiment in which this was not achieved was repeated. It was shown that at 500°C. the centre of the furnace contained a region 10 cm. long in which the ends were only 1.5°C. cooler than the centre. This 'constant-temperature zone' narrows slightly with increasing temperature. The furnace could not be used beyond about 730°C. because steel then undergoes a structural change resulting in a temperature arrest.

The effective dead space of the apparatus was about 2.1 cu. cm. at a presure of 10 mm. Hg, rising to 4.2 cu. cm. at 20 mm. Hg, so that the volume of gas 'lost' owing to this increase in pressure during an experiment is of the order of 2 cu. cm., which is negligible compared with the total volume of gas obtained, about half a litre or more.

Coming next to the method of experimentation, a quantity of air-dry coal (usually 3.00 g.) was introduced into the reaction tube in a boat, which was inverted and pulled out, leaving the coal heaped about the thermocouple pocket. This method was chosen to ensure accurate temperature measurement. The reaction tube was pushed into the furnace, and the apparatus assembled, and flushed several times with helium before the furnace power was switched on.

At the beginning of active decomposition, gas flow rates were small and were measured using the volume defined by tap T5 (Fig. 1), while later, when the flow was greater, the larger volume defined by tap T6 was used.

It was originally intended to sample the gas stream at atmospheric pressure as it passed the gas sampling-point, which was arranged to have no dead space. This was found impracticable, so that the following method was adopted.

First, the high-pressure side of the apparatus was flushed with helium. The gas was then allowed to flow into the space filled with helium until the maximum allowable excess pressure had been built up. This pressure was brought back to atmospheric and a gas sample taken by allowing mercury to run out of the sample bottle attached at the sampling-point, thus drawing the gas into the sample-bottle. The time needed for the recorded pressure increase having been noted, the flow rate at which a given gas sample was developed, was known.

All Gas Used

At the beginning of an experiment, it was necessary to use all the gas produced both to measure the flow rate and to serve as sample, owing to the low rates of gas flow. This limited the resolving power of the apparatus, as the samples, taken at the beginning were not true spot-samples, the first 10 cu. cm. sample taking up to 20 minutes to be collected. The samples (usually 10 to 15 cu. cm.), were analysed by gas chromatography, each being divided into six portions, for three analyses in duplicate. Nitrogen and oxygen (unresolved), carbon monoxide and methane were determined on active charcoal at 70°C., with hydrogen as carrier, and hydrogen and helium were determined on silica gel at 13°C., with nitrogen as carrier, and the higher hydrocarbons and carbon dioxide were determined on a dimethylformamide column at 0°C., again using nitrogen as carrier.

The error in flow measurement is the sum of the errors in the following measurements:—

(a) Gas Analysis. This was shown to be better than 1% accurate, by comparison with a mass spectrometer.

(b) Interval Measurement. The shortest interval during which flow was measured (when the total flow was high) was 2 minutes, measured to about 2 seconds, or 1.7%. For longer intervals, the error would decrease proportionately, say to 0.5%.

(c) Pressure Recording. The main error here is an uncertainty in the zero, amounting to about 1.5%.

(d) Volume Measurement. For large flows, the volume into which the gas was pumped was 24.6 ±0.2 cu. cm.; for small flows, it was 7.2 ±0.2 cu. cm.; errors of 0.8 and 2.8% respectively. The error here is mainly the uncertainty in the position of the point in the pump separating the high and low-pressure sides of the apparatus.

(e) Summation of Errors. Adding these we find an error of 3.4% for small flow rates, and an error of 2.4% for large flow rates. Temperatures were measured to ±1°C., and heating rates to about ±0.02°C. per min., both measurements being sufficiently accurate.

Total gas volumes are determined by integrating the flow rate against temperature curves, and are therefore subject to the errors in flow measurement. Beyond 730°C., methane is estimated by extrapolating the curve, which introduces little error as most of the methane is already developed. Hydrogen and carbon monoxide beyond 730°C. are determined from the weight and ultimate analysis of the residue (See Section VIII (D).) The combined error here is about 4%. As hydrogen and carbon monoxide totals are about equally derived from measurements made before and after 730°C. is reached, the sum of the errors will be about 5%.

The work was carried out on the vitrinites of six bituminous coals, ranging in rank from N.C.B. coal rank code numbers 100b to 802 (94 to 80% C, 8 to 42% d.a.f., v.m.). The exinite and micrinite accompanying one of the vitrinites were also examined.

Hand Picked

The vitrinites and other macerals were prepared by hand picking, followed where necessary by flotation on calcium chloride solutions of suitable density. The air-dry macerals were stored in as large a particle size as possible to prevent oxidation, being ground to about 0.02 mm. by agate ball mill immediately before use.

The anthracite A comes from the Aachen coalfield. The coals H, E and M are from the Dutch State mines in Limburg, and Bv, Be and Mm refer to the vitrinite, exinite and micrinite of a sample of the Beeston seam of West Yorkshire. This coal (then referred to as 'Yorkshire durain') and F, a Lorraine coal were from samples that had been used in the work on macerals by Dormans, Huntjens and van Krevelen.

The results and the deductions from them are set out in detail with tables and graphs.

With the coking coal E (Emma, Rank Code 301), gas flow reaches 0.1 cc per min per g. at about 430°C.; methane reaches its peak at about 500°C., the peak of the higher hydrocarbons is at about 480°C. and hydrogen becomes the most important component at about 560°C.

Curves showing the behaviour of the vitrinite Bv of the W. Yorks high-volatile coal indicate, compared with the coking coal E, a less hydrogen flow, a slightly reduced methane flow and a greater CO flow. In the comparison of the macerals exinite and micrinite with the vitrinite of this coal, the most striking point is the very large difference between the exinite and the other macerals in the rate of loss of weight. It appears that a very large fraction (a third to a half) of the total exinite is found in the tar. It is surprising at first to note that the exinite produces less methane than the vitrinite, as exinite is considered to be much richer in the so-called side chains than the other macerals. The explanation for this anomaly lies in the fact that the gases observed must come from that part of the total that does not appear as tar, which is much smaller in the exinite.

Maximum Flow

Saturated hydrocarbons higher than methane are found to have maximum flow at the same temperature, about 30°C. lower than that of methane. Unsaturated hydrocarbons are found (in Coal E) only in small amounts, the ethylene maximum coming at a significantly higher temperature than the higher members of the series.

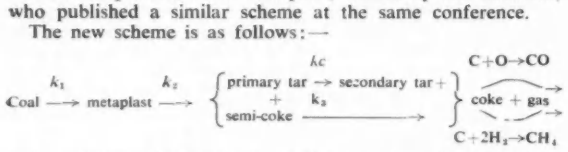
Variation of carbonisation products with rank are shown by plotting against carbon content. The significant observations seems to be that a maximum of methane is developed at about 89% of carbon, while other hydrocarbons reach the maximum at about 87% (on the dry-ash-free basis).

Deductions on the structure of coal are put forward but the author has resisted the temptation to incorporate these results into a coal model.

The ideas developed in this report enable the scheme advanced by the author for the reactions by which the change from coal to semi-coke takes place, up to the end of plasticity.

to be extended beyond that limit, and somewhat changed. In what follows, the author's words 'fluid coal' are replaced by the more expressive term 'metaplast,' coined by van Krevelen, who published a similar scheme at the same conference.

The new scheme is as follows:—



k_1 and k_2 are the reaction velocity constants of the reactions proposed in the papers cited, and k_3 represents the various reactions studied in this Report. k_c represents the cracking reaction of the primary tar, which is not considered, as it is largely suppressed by working at low pressure. The lower curved arrow represents the autohydrogenation reaction, and the upper curved arrow represents the fact that the carbon monoxide observed in the latter stages of the reaction comes from heterogeneous oxygen and carbon; that is to say, it comes from the body of the coke independent of the process of stripping the lamella of its side groups.

The first reaction is now supposed to take place without any gas evolution, while what was called 'gas' in the second reaction is now referred to as 'primary tar,' though, under the conditions of experiment employed in the earlier work, this primary tar will have been largely cracked. In the present scheme, the word 'gas' is reserved for the volatile material other than tar evolved in the reaction leading to coke.

It must be emphasised that all these reactions must be thought of as taking place simultaneously, the product of one reaction being the reactant of the next.

DISCUSSION

Mr. Phillips (National Coal Board): 'I think the topic of this Report is of interest, representing as it does a piece of work which is of a type becoming more numerous on coal. It treats the dynamics of coal changes rather than the details of a static picture of coal structure and I think that in many ways this is a good thing. The details are perhaps not very important and technologically I think the changes which take place in coal in this process are of greater importance. This is one virtue of the work. It is true that Mr. Fitzgerald has made deductions about the structure of coal, the static picture, but I do not think the Report should be judged by the success of those. The more important aspect is the picture of the changes which go on. In Figs. 4 and 5 of the Report the author has given pictures of the evolution of gas against temperatures for two coals, a coking coal and a high volatile coal. It is of interest to see that the coking coal in its evolution of material at 500°C. or 600°C. shows a greater evolution of gaseous material but a lesser evolution of solid tars. I make that deduction from the dashed line which represents the weight loss. So a high volatile coal gives off less gas but more heavy material. There have been studies on the heat reaction of coals reported recently, one by Millard and some by German workers, and the general picture seems to be that the endothermic reactions are of greater magnitude in terms of heat in high volatile coal than low volatile coal so we have to explain away the fact that high absorptions of heat are associated with larger tar losses than gas losses. I find this rather surprising in the light of the author's comments that the tar comes away easily anyway. But there it is, and the more work of that kind that can be done the better. Another direction of investigation would be on these coal models—these large molecules which it is fashionable to investigate as an alternative to coal itself.

High Activation Energy

'In the Report on p. 17 the author discusses the significance of the fall in the slope of the Arrhenius curve. He attributes this to the high activation energy caused by high temperatures. I am not quarrelling with that conclusion. It is reasonable that it should be more difficult to get out the more remote hydrogen atoms and that therefore the energy barrier should rise, but I question the mathematical model put forward in support of this. In my view it incorporates the construction in that it sets up the state of the coal at any one time as a function of temperature only, whereas the essential feature of any model is that it is a function of time as well as temperature. It is true that for a given rate of heating there is a connection between temperature and time but I do not think it is the one which the author intended.

Measure of Exhaustion

'An analysis which supposes that the far atoms are available only after the near atoms are removed, implies a considerable measure of exhaustion of the first reactions being achieved before the later reactions become available, and if there is a measure of exhaustion this must appear in the mathematical model and it will appear, of course, in terms of a time co-ordinate. We have to take account of the time factor. This is quite fundamental, I feel, to the kinetic picture put forward.'

Dr. G. J. Pitt (National Coal Board): 'Why does the maximum evolution of methane from anthracite occur at a temperature 100°C. higher than from most of the other coals which he studied? Mr. Fitzgerald has been very bold in endeavouring to interpret these curves in terms of reactions of kinetics and I question one or two of the first steps he has taken in this process. First, he has made the fundamental assumption that the reactions are first order. Can this be justified either from the results which he found or from a prior knowledge of other systems? If one considers the published work on the thermal decomposition of organic solids, it is extremely difficult to find any indication among the results of first order reactions. In most cases the results published are of curves relating to gas pressure, the pressure of the gas evaluated during the decomposition against time at a constant temperature, and these are not of the exponential form one would expect. They are what is commonly described as sigmoid in character and the conclusion, so far as I can understand the literature, is that even the decomposition of a single simple substance is a complex process and apart from the rupture of the chemical bonds there are other factors of importance. If this is so for pure organic compounds how much more would it not be so for coal if, in fact, as Mr. Fitzgerald suggests, his results indicate that the reactions are first order. Even then I think there is still a good deal of explanation required as to why this should be so.

Inescapable

'The author has interpreted the change of slope of the Arrhenius plot as indicating that there are CH compounds which differ among themselves in their activation energy. This, I think, is almost inescapable as an assumption, but I feel that the treatment he has given is not as regularised as would be necessary if, in fact, one was faced with this situation. Supposing one has two reactants undergoing thermal decomposition; each one decomposes according to the first order reaction—they give the same product, but their activation energy is different. If one follows through the mathematics of this process one finds that the overall order of the reaction, treating the system as a whole, is no longer first order. The form of the curve does not permit one to estimate the activation energy, or even the average activation energy of the two reactions. I see no way of overcoming this difficulty in respect of the author's results, but I suggest that it would be very valuable if it were possible to carry out a series of experiments of the type which are reported here, but at a series of constant temperatures whereby one could follow the rate of evolution as a function of time.'

Gas Catering Equipment

THE Gas Council have now brought out the second edition of their 'List of tested and approved gas catering appliances.' Available now free of charge from area gas board offices and showrooms, the list—first published a year ago—is issued as a companion publication to the Council's domestic appliance list. All the appliances on the list have been tested in accordance with British Standard 2512 (1954), 'Gas heated catering equipment.'